AIR | ENGINEERING

MAY, 1961

MAKING AIR COMFORTABLE, HEALTHFUL, SAFE, AND USEFUL FOR PEOPLE, PRODUCTS, PROCESSES

THE UNIVERSITY OF MICHIGAN
MAY 17 1961
ENGINEERING LIBRARY

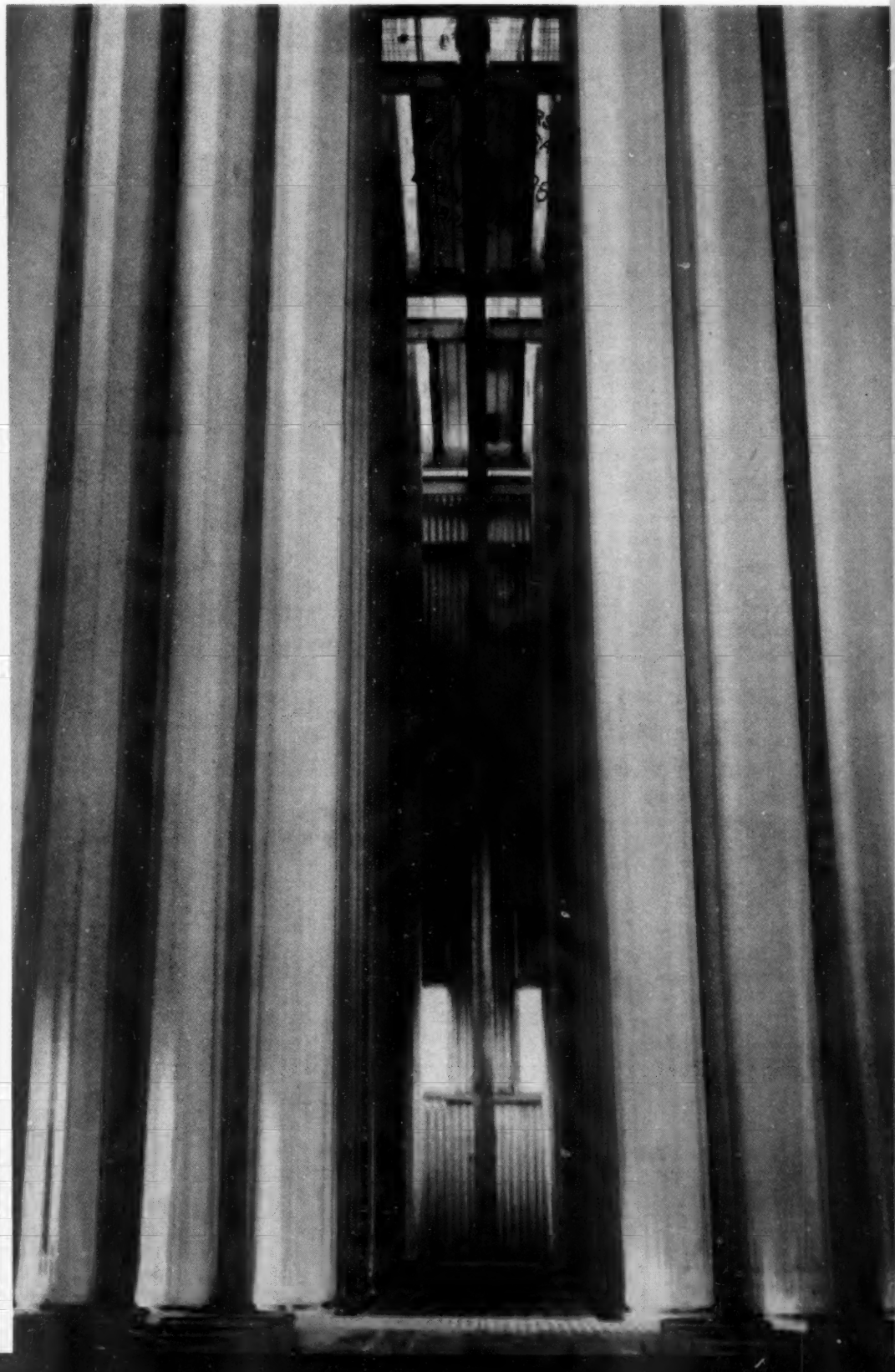
IN THIS ISSUE

Factory Air Conditioning Boosts Blouse Production 59%!

Ventilation Tips For Bag Packing Of Fine Chemicals

Quality Control Of Air At Autonetics Cuts Rejects!

New Approach o Electric urnace Dust ollection!



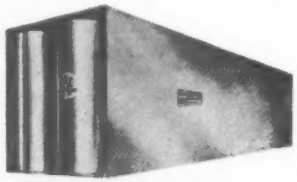
Fan Noise CONTROLLED in Air Handling Systems QUICKLY & ACCURATELY in less than 5 minutes!

Recognition that noise generated by fans in air handling systems could be predicted and controlled has led to a series of developments in both the "calculations" and also the necessary noise control equipment.

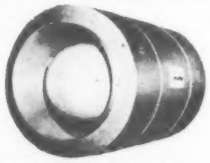
Guesstimating has now been eliminated by the general acceptance of these 4 important steps, functions and/or considerations: (1) that the total fan noise and its spectrum is substantially per the ASHRAE GUIDE dated 1957 or later (2) that we now have workable data covering the natural noise reduction due to ductwork, elbows, splits, distances, end reflections, room absorptions, etc. (3) that we have NC and NCA criteria for each of the 8 octave bands for most types of areas and we can now specify what is desired, and more important, by using an octave band analyzer, it can be readily determined whether the specified criteria has or has not been met (4) the development of prefabricated noise reduction units (noise traps, sound traps, etc) which have been properly factory tested and rated so they can be used with the method mentioned above.

"Short Form" Makes Selection Easy

Since that time, because of the progress made in the design of Quiet-DUCT Silencers, and the wide acceptance of newly developed techniques mentioned above, the "Short Form" has been developed to make the selection of unit silencers for air handling systems an easy matter.

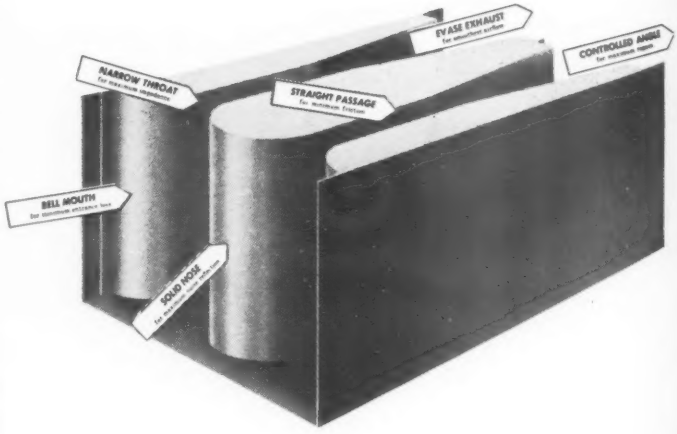


QUIET-DUCT SILENCERS
4 STANDARD MODELS
4 LOW PRESSURE MODELS
44 UNIT SIZES
90 MULTIPLE UNIT SIZES



CONIC-FLOW SILENCERS
18 STANDARD UNIT SIZES

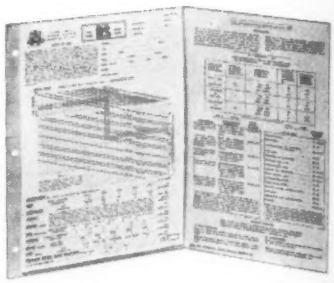
"Cut-Away" View Reveals New Design of "Packaged" Quiet-DUCT Silencers.



Over ten years of experience in controlling noise in air handling systems has resulted in this new, basic design for all "packaged" silencers manufactured by our company. Design requirements include: *Bell Mouth Entrance* for minimum air pressure loss; *Solid Nose* for maximum noise reflection; *Narrow Throat* for maximum noise impedance. *Straight Passages* provide smoother airflow with more silencing and less regenerated noise. *Less Pressure Drop* is achieved by the diverging design of the evasè exhaust, keeping turbulence at a minimum and attaining maximum pressure regain.

The "SHORT FORM" consists of a small binder containing a pad of 25 reproducible work sheets. Only one such sheet is necessary to quickly and accurately resolve each noise problem and determine whether silencers are required, and if so, the silencer model needed to provide the Noise Reduction required for the problem. The "SHORT FORM" gives the Noise Reduction required in the 3rd octave band (in decibels) based on the data and procedures published in the ASHRAE GUIDE & DATA BOOK. Many field experiences have demonstrated that 3rd band calculations, by themselves, are a reliable index to silencing requirements as related to air handling systems. Because of the inherent characteristics of the "packaged" Quiet-DUCT silencers — if silencing is required in the 3rd Band, and the unit silencer is selected based on this criteria, more than enough noise reduction will be provided for all other bands as well.

The "SHORT FORM" is available through our representatives or write direct.



IAC
Your Standard of Silence

INDUSTRIAL ACOUSTICS COMPANY, INC.

341 Jackson Avenue New York 54, N. Y.

Representatives in Principal Cities

[For more information circle #11 on page 51 reply cards]

AIR ENGINEERING

VOL. 3, NO. 5

MAY, 1961

MAKING AIR COMFORTABLE, HEALTHFUL, SAFE, AND USEFUL FOR PEOPLE, PRODUCTS, PROCESSES

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Air Conditioning Raised Ship 'N Shore Production 59 Percent 26

Statistics proving that for an investment of only 2.8¢ per manhour, air conditioning raised production at Ship 'N Shore.

Super-Clean White Rooms For Precision Components 28

by W. R. Jerome, Autonetics Div., North American Aviation. Author tells how Autonetics designs and builds white rooms for precision missile work which cut rework rate from 1200% to 20%.

550° Gas Cleaned By A Glass-Fabric Baghouse 33

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Four Ways To Control Dust At Bag Fillers 34

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Dust Collection Methods For Steam Power Plants, Part II 36

by Gregory Gould, president, Fuel Engineering Co. Practical and economical ways to obtain efficient particulate collection from your power plant.

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COVER

The cathedral-like atmosphere of the front cover illustration actually is a glass-fabric baghouse at Bethlehem Steel's Seattle plant. See page 33 for the story.

AIR ENGINEERING is published monthly by Business News Publishing Company, at 450 West Fort Street, Detroit 26, Michigan. Subscription prices: United States, Canada: $3.00—1 year; $4.50—2 years; $6.00—3 years. Foreign: $5.00—1 year; $8.50—2 years; $12.00—3 years. Single copies 50 cents. Second-class postage paid at Detroit, Michigan. First issue April, 1959. • CHANGE OF ADDRESS. Notify AIR ENGINEERING and your local Post Office of both your old and new addresses including postal zone numbers by 12th of preceding month.
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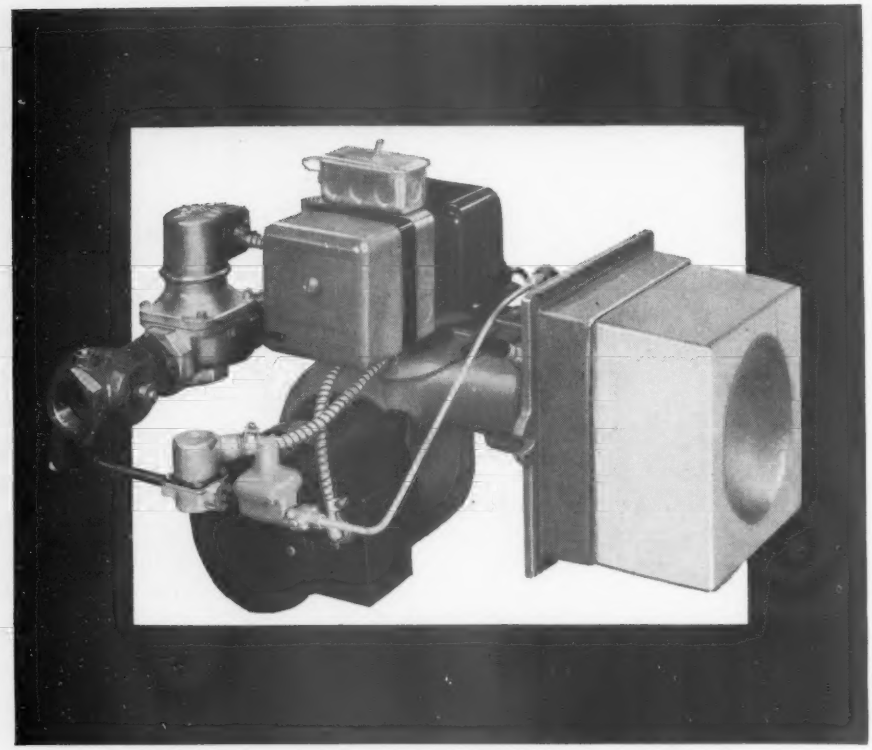


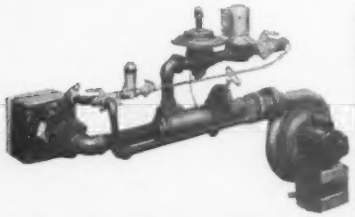
Ready-to-install incinerator burner assemblies "custom-made" to your requirements

From the broad range of Eclipse packaged incinerator burner assemblies — available as standard catalog items — you can select the exact "custom-made" burner that will solve your incineration smoke and odor problems on any job and assure complete satisfaction.

All models are factory-assembled, tested, and shipped complete, including combustion block, ready for installation.

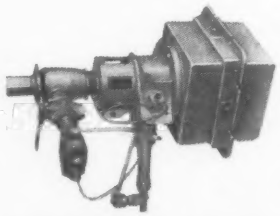
Model 800 SIB, shown above, has a capacity range from 100,000 - 900,000 Btu/hr. Package includes pilotstat or electronic flame safety protection, spark ignition, and blower for combustion air. Available in five different assemblies for a variety of needs.

Bulletin H-51-C describes this burner assembly in detail. Write for your copy today.



BLAST TORCH BURNERS

Three sizes — 400,000 to 1,200,000 Btu/hr. Produce hard flame, higher temperatures, more capacity for tough incineration jobs. Write for Bulletin H-50.



ATMOSPHERIC BURNERS

Six sizes — 50,000 to 500,000 Btu/hr. Operates on nominal draft — no blower or electricity — for incineration of readily combustible materials. Write for Bulletin H-52.

Eclipse®

COMBUSTION DIVISION
ECLIPSE FUEL ENGINEERING COMPANY
1120 Buchanan Street, Rockford, Illinois

Letters

Recommends White Room Directory

Editor:

I do hope you are maintaining that directory on White Room Suppliers, etc., for I've been recommending it as an impartial source. Such a directory made available by you is helpful as it is needed by industry in general, and it assists me in my work, for we at Sandia must be careful not to favor one supplier over another. I get several requests each week for the names of companies or persons who are engaged in white room equipment and services, so please keep that directory up-to-date.

I. M. Kodel
Sandia Corp.
Albuquerque, New Mexico

Editor's Note:

To receive a copy of the White Room Directory—

Circle #171 on page 51.

Praise Of Air Engineering

Editor:

Your publication, AIR ENGINEERING, has been improving steadily in every department, especially in the timely selection of subject matter and in the reliability of technical information.

John F. Murray
Power Consultant
Department of Water & Power
City of Los Angeles

Authors Omission

Editor:

In your February issue, you published a very excellent article titled "The Economies of Factory Air Conditioning" in which you included a list of fourteen practical ways to reduce cooling costs.

The author omitted one very important method that has had wide application and advantages. I am referring to the use of activated carbon equipment in the recirculated air system. Obviously,

(Please turn to page 6)

[Circle #15 on page 51]→

[For more information circle #14 on page 51 reply cards]

Oil burners in California... and coal burners in New Jersey...agree:

Electrostatic Precipitators catch fly ash at Sewaren steam power plant

When DUST is your problem— CLEAR IT WITH WP

For an efficient, economical solution to any dust control problem—look to Western Precipitation. WP is uniquely fitted to handle your unique problem—being the one organization that custom designs, engineers and installs ALL types of dust and fume control equipment: Precipitator, Mechanical, Jet-Cleaned Filter, Hi-Temp Filter, scrubbers and engineered combinations.

With no axes to grind for any one system, WP engineers will give your job a completely unbiased recommendation—whether it's a quote on your specifications, a single component, or a completely engineered installation... small, major, simple, or complex.

An inquiry—on your business letterhead—will bring you literature promptly. Just write Western Precipitation, 1000 W. 9th St., Los Angeles 54, Calif. (In Canada, write 8285 Mountain Sights Ave., Montreal, P.Q.)

Dust and fume control since 1907

WESTERN PRECIPITATION

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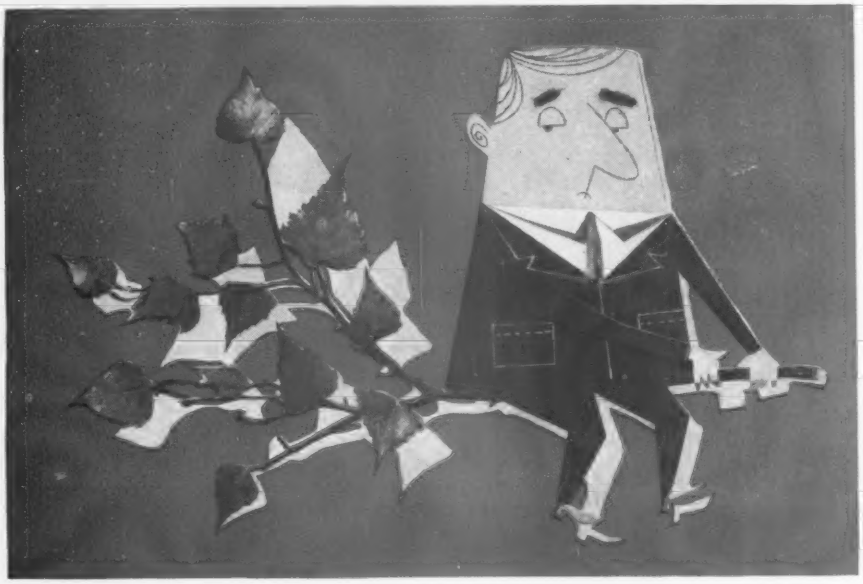
Division of Joy Manufacturing Company

ELECTROSTATIC Precipitators
MULTICLONE Collectors
CMP Combination Units
DUALAIRE Jet-Cleaned Filters
THERM-O-FLEX Hi Temp Filters
TURBULAIRE Scrubbers
JOY-MICRODYNE Scrubbers
also: **HOLO-FLITE** Processors
HI-TURBIANT Heaters
TURBULEX Calciners

Don't Get out on a LIMB...

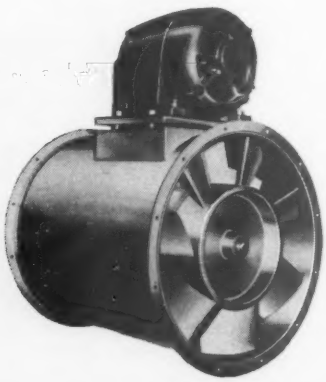


insist on the vaneaxial blowers

which are designed specifically

for rough, tough industrial service

...HARTZELL VANEAXIAL BLOWERS



Compare the specifications on Hartzell Vaneaxial blowers with those on other units of the same type. Note for instance the heavier gauge steel used on the Hartzell units, the heavier over-all construction, the fact that Hartzell welds the guide vanes to both the inner and outer shells. You'll quickly see why Hartzell vaneaxial blowers stand up better . . . last longer, require less maintenance. And Hartzell vaneaxial blowers are now available in eleven sizes, 12" to 60", including the one that's just right for your application.

For complete details, just give your nearby Hartzell field engineer a call. You'll find him listed in the Yellow Pages or in the Hartzell catalog in Sweet's Plant Engineering and Industrial Construction Files.

Hartzell PROPELLER FAN COMPANY

Division of Castle Hills Corp. • PIQUA, OHIO

(HARTZELL)

[For more information circle #16 on page 51 reply cards]

Letters

(Continued from page 4)

factory air conditioning will generally require more than usual amounts of outside air to overcome stale or contaminated air conditions. This will therefore result in the need for more refrigeration equipment.

As an economical alternate, the use of carbon will cut down on the outside air requirements and, naturally, lead to initial equipment cost savings and ensuing operating costs.

It can be generally estimated that a possible 20 percent savings in initial equipment can be achieved by using activated carbon. Furthermore, for each dollar spent for annual maintenance of the carbon, there is a savings of about $4.00 in refrigeration equipment power costs.

It may be of interest to your readers that Chicago's Exposition Center saved 800 tons of air conditioning capacity by using Dorex Activated Carbon Filters.

Should any of your readers desire a breakdown of typical costs showing the savings to be achieved using activated carbon as against outside air, we would be most pleased to furnish them with such a chart.

B. N. Egrin
Connor Engineering
New York District Manager

Circle #200 on page 51.

New White Room Organization

Editor:

As air conditioning engineering contractors, we are especially interested in your magazine because it deals primarily with industrials, which are our "bread and butter." Specifically, we are interested in ASCCA, and any data connected with White Rooms.

In 1955 our firm made an installation at Fafnir Bearing Co., and for lack of a better word, we called it the "Super Room." I am enclosing a flyer on this installation.

At that time there was very little data available for such an

(Please turn to page 10)

AIR ENGINEERING

Publisher: E. L. Henderson
Assistant Publishing Manager: P. A. Schildhammer
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EDITORIAL ADVISORY BOARD: George F. Taubeneck • Phil B. Redeker • C. Dale Mericle
REPRESENTATIVES: NEW YORK 17—521 Fifth Ave., MUrray Hill 2-1928-9, R. M. Price, F. L. Taylor.
CHICAGO 3—134 S. LaSalle St., FRanklin 2-8643-4, M. R. Smith, D. Ryden.
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EDITORIAL:

You'll Never Have A Better Excuse . . .

THE BUILDING industry is hightailing it out of last year's slump, urged on by economic bellweathers which point to a substantial upsurge in non-residential construction in 1961.

Right now, however, the tail-end of the slump is still with us, competition is keen, equipment prices are being shaved to the bone and contractors and engineers have open time.

You'll never have a better excuse to push ahead your program for installing air conditioning, heating or industrial ventilation equipment in your building.

In your effort to secure management o.k. you can point to the fact that manufacturers are straining their buttons to give you the lowest possible price on equipment.

For example, Carrier Corporation reports that prices have dropped markedly on centrifugal refrigeration machines during the past three years, with the industry average down 11-percent. In general, the price for centrifugals is today $50 per ton as compared with $100 per ton a few years ago. Over all, complete air conditioning system equipment prices are about 15-percent lower today than three years ago.

Competition between contractors is also fierce, with 15 or 20 of them frequently bidding on the same job. Consulting engineers can handle your work promptly now too. The engineers who work for mechanical contractors will be anxious to work out shortcuts and hammer out best possible prices for you all the way down the line.

Money is "loose" right now, and at favorable rates, which in turn contributes to lower bid prices on the part of contractors.

These favorable conditions are due for a sharp change later on this year, which is why we urgently recommend that you get your plans rolling as fast as possible *now* to take advantage of existing lower prices . . . or more cooling, heating or ventilation for your dollar, whichever way you want to look at it.

(Please turn to following page)

NOW--rid your White Room of the Unseen Enemy

If you're still using mops and brooms to clean your white room, chances are there's an unseen enemy lurking overhead or underfoot, ever ready to destroy high quality standards. The extreme care required for the assembly and testing of delicate instruments, precision devices and other equipment calls for special housekeeping techniques.

Hoffman vacuum systems get rid of the unseen enemy—solve tough production cleaning and general maintenance problems—provide maximum efficiency.

To insure truly superclean white rooms, call on Hoffman, pioneers in the development of engineered equipment for dust-free facilities. Hundreds of Hoffman white room systems in plants of all types say we know how.

Write for vacuum equipment catalog and a survey of your white room needs. No cost or obligation.

AIR APPLIANCE DIVISION
HOFFMAN
INDUSTRIES, INC.
A SUBSIDIARY OF HOFFMAN INTERNATIONAL

Dept. AE-2 • 103 Fourth Avenue • New York 3 • ORegon 7-3600

[For more information circle #43 on page 51 reply cards]

EDITORIAL

(Continued from preceding page)

The upswing in factory, commercial and other public and private non-residential building is projected to rise 5-percent to $3-billion dollars this year and public construction (schools, government office buildings and the like) is in for a 5-percent rise to a total of $17-billion for this classification.

Commercial construction, including office buildings and warehouses, is scheduled for a healthy 10-percent upswing. Church construction is due for a heavenly 3-percent growth and hospitals, thanks to the Hill-Burnett Federal aid fund, are due for a healthy rise in construction.

School construction, reflecting a suburban population growth, is forecast for a record high of $3-billion, and the money to support this growth has already been approved by the citizenry in the form of voted-on-bond issues.

The missile business, thanks to competition from abroad as well as to the new administration's plans for defense and retaliation, is to hold its growth rate steady at the 1960 level, which means $1.35-billion for facilities added to this segment of the economy in 1961.

The chemical industry is in for a whopping 40-percent rise in plant facility, according to the Manufacturing Chemists' Association.

Competition for your dollar has spurred a 370-percent rise since 1954 in construction of research and development facilities, with $197.7-million spent for labs and the like in 1960.

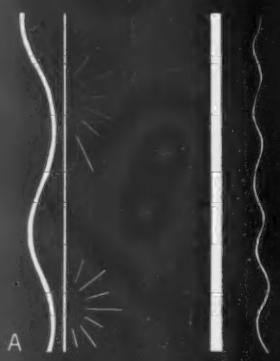
So what we've said about expediting your plans for air conditioning, heating and/or ventilation equipment applies with especial emphasis if you're in the electronic, missile, chemical, metal working, plastic, pharmaceutical, instrument or related industries.

It makes sense to buy while the market is most favorable . . . and that time is *today!*

(Please turn to page 16)

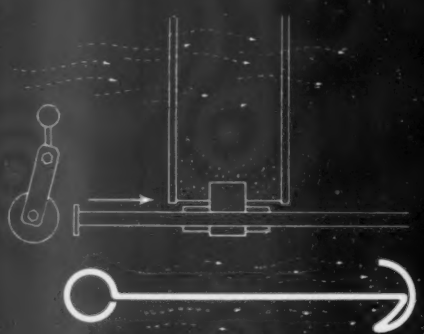
COLLECTING ELECTRODE DESIGN ANOTHER REASON FOR SUPERIOR PERFORMANCE OF BUELL PRECIPITATORS

HEAVIEST CONSTRUCTION, ONE-PIECE FABRICATION Rolled, from a single piece, the structural design and thickness of the Buell collecting electrode provides the strength to retain proper shape and alignment in erection and operation.



EASE OF HANDLING AND INSTALLATION – Rugged sections can be installed without bending or distortion thereby eliminating the possibility of 'arc-overs' (A).

OPTIMUM FLEXIBILITY IN DESIGN OF PRECIPITATOR –Standard 16" width (B) allows increase in size of precipitator by smaller increments (not by 3 foot (A) or longer sections). Permits economical sizing of precipitator to specific requirements of efficiency and space.



POSITIVE "SHEARING ACTION" DESIGN – No reentrainment of dust in rapping. Each row of electrodes is rapped separately—in the direction of the gas flow—on a continuous cycle. Dust is sheared off, drops in an agglomerated mass, and pockets on electrodes minimize reentrainment.

Add to this Buell's exclusive baffling system adjustable after installation for uniform distribution of gas flow, sealed insulators, rigid, 4-point suspension of emitting system, and high emittance, minimum maintenance Spiralectrodes and you have a combination that's hard to beat. You'll be glad you decided on Buell precipitators when you experience superior performance and minimum maintenance. Buell Engineering Company, Inc., Dept. 62-E, 123 William Street, New York 38, New York. Northern Blower Division, 6417 Barberton Avenue, Cleveland, Ohio. Electric Precipitators • Cyclones • Bag Collectors • Combination Systems • Fans • Classifiers

buell Norblo

[For more information circle #17 on page 51 reply cards]

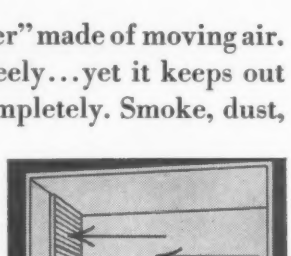
the CLOSED door that's always OPEN

"Air Curtain" in use at Merchants Refrigerating Company, Vinita Park, Mo. It separates −10°F freezer area from shipping dock.

The American Air Curtain is a "barrier" made of moving air. It lets people and products move freely...yet it keeps out cold, heat, wind, rain, or snow—completely. Smoke, dust, and insects can't penetrate it.

Use it for a loading platform entry. Use it for confining paint fumes, heat from bakery ovens or die-casting machines, or cold storage spaces.

Chances are there are a dozen good uses in your plant for an American Air Curtain. Write us for complete details.



In this case, air travels horizontally to form a barrier between rooms of different temperatures.

AMERICAN AIR CURTAIN
A DIVISION OF UNIVERSAL MATCH CORPORATION
ST. LOUIS 35, MO. • NEW YORK 18, N.Y.

[For more information circle #24 on page 51 reply cards]

Letters

(Continued from page 6)

undertaking, and we had to use a great deal of ingenuity. We're proud to say that many of the ideas we had used have been carried on in subsequent White Rooms, and are again being used on an installation we are currently making.

Since we are in the center of the electronic industry of the east; Perkin-Elmer Corp., Norden, Sperry Semi-Conductor, Vitromon, and a host of others where White Rooms are a "must," we are interested in any data published on clean rooms.

I missed the December, 1960 issue of your magazine. Would you please send us a copy and bill us for it?

D. B. Klein
J. P. Salmini Company, Inc.
Milford, Conn.

Would Like Readers' Comments

Editor:

We have several operations that are done in air conditioned spaces. In some of these operations the exhaust requirements are quite high accounting for 50 percent or more of the required tonnage. I would like to hear some reader comments on reducing this tonnage by such means as using lower design wet and dry bulb temperatures, providing separate unconditioned air supply to exhaust operations, or any other means that may have been successful.

R. P. Hibbard
Fansteel Metallurgical Corp.
North Chicago, Illinois

Statistics And Costs On Air Conditioning For Comfort

Editor:

I believe I have seen articles and statistics in your magazine pertaining to types and proportion of industry using air conditioning generally for employe comfort.

I am endeavoring to convince our management of a more liberal

(Please turn to page 24)

Designed for Architects • Engineers • Contractors

Whatever the architectural specifications, the slim-trim distinctive design of Stripline extruded aluminum slot-type diffusers blends in perfectly with the general decor. Stripline with separate mounting frames and interchangeable cores eliminates screwholes, leaves the decorative surface unmarred.

Stripline is INCONSPICUOUS . . . PRACTICAL, can be located anywhere to suit the interior designer's preference...in walls...ceilings...coves...moulds... window sills. Stripline is supplied as a continuous decorative unit, or in sections, to meet any requirements of interior treatment or airflow.

Unlike side wall grilles and air discharge slots, Stripline diffusers incorporate the exclusive Agitair diffusing vanes. These built-in diffusing vanes produce extremely high turbulence and aspiration... achieve rapid temperature equalization...insure the distribution of tempered air unvaried over a predetermined area without any noticeable air motion.

In the design of Stripline extrusions, top priority was given to solving the contractors installation problems. These units are now made with interchangeable cores and separate mounting frames for surface or plaster installations. An integral part of each diffusing core is the unique coil spring-lock which further facilitates the installation of Stripline when used as a continuous unit or where sections are required. This spring-lock feature locks the unit firmly in place, and eliminates the use of screwholes and screws.

For more information write for
technical catalog ES-105

AIR DEVICES INC.

185 MADISON AVENUE • NEW YORK 16, N.Y.

BETTER PRODUCTS FOR
AIR DISTRIBUTION • AIR CLEANING • AIR EXHAUST

[For more information circle #18 on page 51 reply cards]

All the air problems of thi
solved with *one syste*

Unique requirements of Montana State structure point up AAF's capability for complete air engineering

WHEN you decide to house the departments of Zoology, Wild Life, Microbiology, Bacteriology and Public Health in one building, you know that some special and unusual air problems must be solved.

The air in Montana State's Health Sciences Building had to be cleaned, cooled, heated and moved—all in varying degrees to meet the special needs of animal environment and isolation rooms, surgery rooms, sterile transfer rooms and research labs.

The job called for many different types of component equipment plus the knowledge and experience to coordinate its functioning into one custom-engineered system. The building planners turned to AAF — the one company that provides all the major components for an engineered air system. Result: one system of completely conditioned air . . . one responsibility for its performance.

Booklet 518 describes the complete line of AAF component products. For a free copy, address Mr. Richard Smith, American Air Filter Company, Inc., 305 Central Avenue, Louisville, Kentucky.

American Air Filter

BETTER AIR IS OUR BUSINESS

AIR CLEANING: (Atmospheric Dust) AAF electronic air cleaners, viscous impingement filters, *dry-type filters,* engine & compressor filters. (Process Dust) electrostatic precipitators, wet-type collectors, dry-type collectors, fabric arresters. AIR CONDITIONING, HEATING & VENTILATING: Herman Nelson *air conditioning unit ventilators,* unit ventilators, portable heaters; Kennard/Nelson dual-duct air conditioning units, *multi-zone air conditioning units,* packaged central station air handling units, sprayed-coil dehumidifiers, *fan-coil units, packaged liquid chillers, cooling towers,* evaporative condensers, direct-expansion coils, water coils, steam coils, unit blowers, industrial exhausters, centrifugal fans, unit heaters, radiation products; Illinois traps, valves, specialties, heating systems and controls.

● *Italics denote products used in Health Sciences Building*

HEALTH SCIENCES BUILDING, Montana State University, Missoula, Montana. Architects & Engineers: Witwer & Price, Missoula; Structural Engineers: Lyerla & Peden, Spokane, Washington; Electrical Engineers: James F. Parr, Hamilton, Montana; Mechanical Contractor: Reber Plumbing & Heating, Helena, Montana.

thiniversity building
tenfrom *one source...*

AAF

AIR CLEANING PRODUCTS
Air Filters
Dust Collectors

AIR CONDITIONING, HEATING & VENTILATING PRODUCTS

COMPLETELY CONDITIONED AIR

Lightweight

Hi-Volume

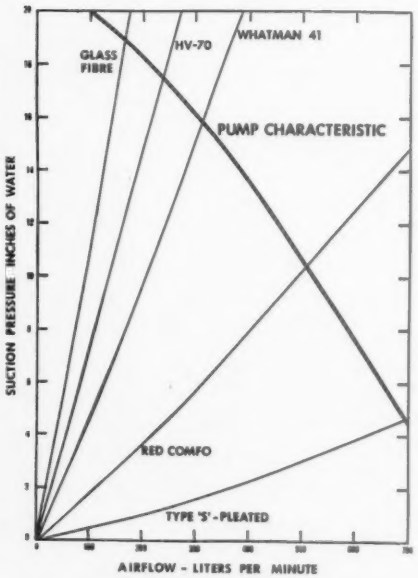
Unico 300

Air Sampler

Developed By The
Atomic Energy Commission
Health And Safety Laboratory

In tests conducted on the Unico 300 Air Sampler with Whatman 41 four inch diameter paper, the unit ran 427 continuous hours without overheating or motor damage. Constructed of high-impact styrene and machined aluminum, the Unico 300 weighs only 3½ lbs.

Priced At $75

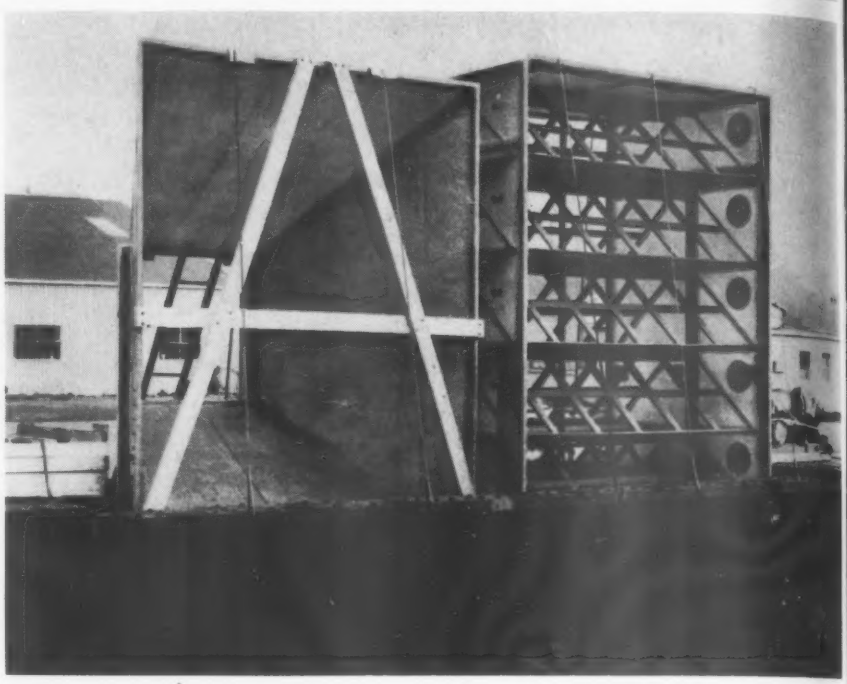


Write For Bulletin X-32

Union Industrial Equipment Corporation
Port Chester, New York

[Circle #40 on page 51]

NEWS of the Industry . . .



Air Washer To Collect Acid Mists From Metal Processes

An industrial air-washer so large it had to be shipped in a special low-bottom flatcar, has been delivered to a major metal refining firm. This unusually large air washer is constructed entirely of lightweight, impact and corrosion resistant resin-bonded fiberglas. It is part of an air purification system collecting acid mists from a metallurgical process and discharging harmless gases into the atmosphere.

Acid mists are drawn through the air washer by an exhauster. In the washer, the air stream passes through banks of fiber media which are continuously under a fine liquid spray. The acid contaminants are removed by intimate contact with the wetted fiber surfaces. The entire structure is constructed of resin-bonded fiberglas with the exception of the piping and other miscellaneous fittings which are constructed of PVC.

The equipment was fabricated by du Verre, Inc., Arcade, New York, to design and engineering specifications by Buffalo Forge Company, Buffalo, New York.

Future Markets For Air Conditioning

According to a *Chain Store Age* survey, 12,900 chain stores were air conditioned in 1960 for a cost of $130,300,000 and the plan for 1961 is to air condition 13,050 stores at a cost of $138,500,000.

The survey is based on reports from 395 chains operating a total of 22,483 stores.

In 1960, 10,130 new chain stores were built and 12,050 were substantially remodeled, a total of 22,180 store projects. Of that total, 12,900, or some 51 percent were air conditioned.

For 1961, 10,790 new chain stores are planned, in addition to 11,375 major remodelings, a total of 22,165 projects. Of that total, 13,050 will be air conditioned, about 59 percent, the survey found.

Virtually 100 percent of the new chain stores opened are air conditioned, says *Chain Store Age*. About one-fourth of the major re-

(Please turn to page 16)

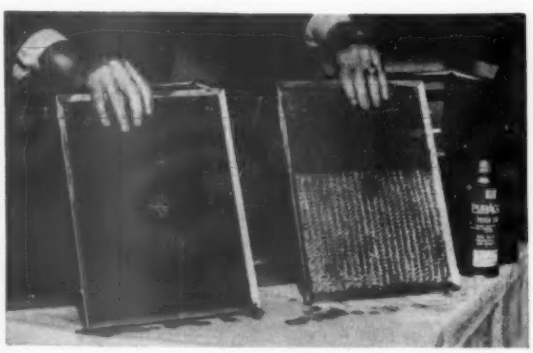
"Fresh as a Daisy" Indoor Air...
Without Hot, Messy Filter Cleaning

NEW PURACON FILTER COAT Cleans Indoor Air Cuts Filter Maintenance Cost

Puracon Filter Coat was developed especially for and first used in treating air conditioning and heating filters in hospitals to promote a bactericidal atmosphere in operating rooms, hallways and patients' rooms. Puracon presents a wholly new concept in clean air control by killing air-borne bacteria and odor-carrying micro-organisms on contact (99.9%). A special patented process scientifically blends glycols into a super-adhesive coating that effectively traps dust, fly ash, pollen and lint on any type filter; and, being water soluble, Puracon eliminates the need for detergents or hot water cleaning. Puracon treated filters rinse clean instantly in cold water, carrying dead bacteria and other contamination down the drain. A built-in detergent leaves filters ready for simple recoating and installation.

Packaged in convenient 16-ounce aerosol cans for home use, Puracon hygienically cleans indoor air for less than a penny a day. For institutional or commercial use, Puracon is available in 1, 5, 15, 30 and 55 gallon containers.

Write Worth Chemical Products Co., Box 366, Fort Worth, Texas for full information or mail coupon below.



A filter treated with Puracon and a filter coated with a popular oil-base filter coating were contaminated by the same system. After a 10-second immersion in cool water the oil-coated filter shows no noticeable change other than being wet. The Puracon filter is bright and clean.

PURACON®

Pure Air Control
FILTER COAT

WORTH CHEMICAL PRODUCTS CO.
Box 366, Fort Worth, Texas

Please send more information about new PURACON.
I am primarily interested in . . .

Puracon in Spray-on Containers ( )
Puracon in Bulk Containers ( )
Puracon Distributorship ( )

Name_____

Firm_____

Address_____

100

[For more information circle #13 on page 51 reply cards]

NEWS of the Industry . . .

(Continued from page 14)

modelings call for the addition of air conditioning. In most branches of the chain store business, a major remodeling involves air conditioning unless the store already has an installation.

Church Air Conditioning

Look for a growth in air conditioner sales to churches. Not only does it enable the church to shut out the drone of outside noises during the summer, but it is a relief to the sufferers of pollen allergies.

A survey has shown that church or temple air conditioning has improved attendance from 25 to 40 percent.

The number of people aged 50 or over was about 39 million in 1958, and will rise to almost 50 million by 1970. Many of these people will move into apartments as their children go away to school.

According to market analysts there is plenty of reason why apartments can be expected to account for a third or more of all dwelling starts during the next four years.

Modern Waste Disposal
DEMANDS
MODERN
INCINERATORS

Every Morse Boulger Custom-Engineered Incinerator has built-in air pollution control!

Consult us without obligation.

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MORSE BOULGER, INC.
Today's Engineering Backed By More Than 70 Years' Experience

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Dept. 15, New York 11, N. Y.
WA 9-8000 • Representatives Everywhere
MEMBER
Incinerator Institute of America
Air Pollution Control Association

[Circle #20 on page 51]

EDITORIAL

(Continued from page 8)

AIR ENGINEERING Is Now ABC

AIR ENGINEERING has this month been accepted as a provisional member of the Audit Bureau of Circulation (ABC).

What is ABC and what does it mean to you, our reader? ABC is an organization that polices the paid circulation statements of magazines which, like AIR ENGINEERING, choose to reach only the reader who will *pay* for the publication . . . as compared to those magazines which are distributed free.

ABC's trained auditors maintain strict surveillance over such things as who the magazine goes to, how much the reader pays for his subscription, the reader's occupation and location, and frequency of subscription renewal.

Subscription renewal rate is an especially valuable indicator to your editors, since by checking occupations of those who renew their subscriptions and those who don't, we can keep close tabs on who is interested in what we publish and who isn't.

We find, for example, that our present healthy renewal rate comes mainly from consulting engineers, plant engineers and multi-plant facility directors, who in the main are the three important groups AIR ENGINEERING is devoted to.

Through ABC circulation audit you exercise your voice in the editorial policy of AIR ENGINEERING. It is you who by your original paid subscription and later renewal of this subscription, tell us that what you read in AIR ENGINEERING is helpful and valuable to you.

In fact you knew, even *before* you subscribed, that you would find much of value in a paid circulation publication like AIR ENGINEERING, simply because thousands of other fellow engineers had already paid for the same magazine.

That's why paid circulation publications *must* exercise great care in choice of editorial material, since it is only by *content* that it wins readers.

The magazine you *pay* for is the magazine you read first, reach for more often, and keep on file for future reference.

We are indeed grateful not only for your interest as expressed by your original subscription but equally as grateful for your continued approval in the form of a healthy subscription renewal rate. We pledge ourselves to continue to serve and to be alert to your professional needs and interests.

Results Of School Ventilation Study

A study has been made to determine the specialized requirements of the school market with respect to heating, cooling, and ventilating was made by the company.

The study was a combination of approximately 100 personal and mail interviews of architects, engineers, editors, and educational building consultants in 25 major cities. Also, representatives checked plans and specification for over 200 schools to catalog types, quantity, and makes of equipment being used. In addition architects and engineers were interviewed by engineering people for their ideas.

What were the findings of these combined reports?

One of the most significant results of the reports was the importance of building design trends aimed at reducing or at least maintaining present cost levels in the face of rising construction and equipment costs.

These trends were found to be important in their effect on both the selection and design of heating-cooling equipment.

(Please turn to page 20)

Chemico P-A Venturi Gas Washer Chosen By Granite City For New Blast Furnace

The venturi washer at the Granite City plant is just one of fifty CHEMICO venturi washers specified and installed by major steel producers for cleaning blast furnace gas. Performance figures and maintenance records of blast furnaces using CHEMICO venturi washers indicate the following:

1 The CHEMICO venturi washer is the most efficient wet washer in operation anywhere. Where higher top pressures are available, for example, gas can be cleaned to less than 0.003 Gr/Scf, eliminating the need for secondary precipitators.

2 CHEMICO venturi washers require virtually no maintenance for an entire furnace campaign.

3 Capital and installation costs are less than other primary or secondary gas cleaners.

4 Minimum space is required. Generally, the CHEMICO venturi washer is set into space formerly occupied by gas mains.

5 Water requirements are about a third of other wet washers.

6 Latest designs incorporate adjustable controls which enable maximum gas cleaning efficiency to be maintained regardless of wind rate.

If you are considering the installation of gas cleaning equipment on a blast furnace, a CHEMICO representative would be pleased to show you the kind of top-performance job you can expect from a Venturi washer. CHEMICO handles the complete job, **Planning, Design, Engineering, Erection and Start-up.**

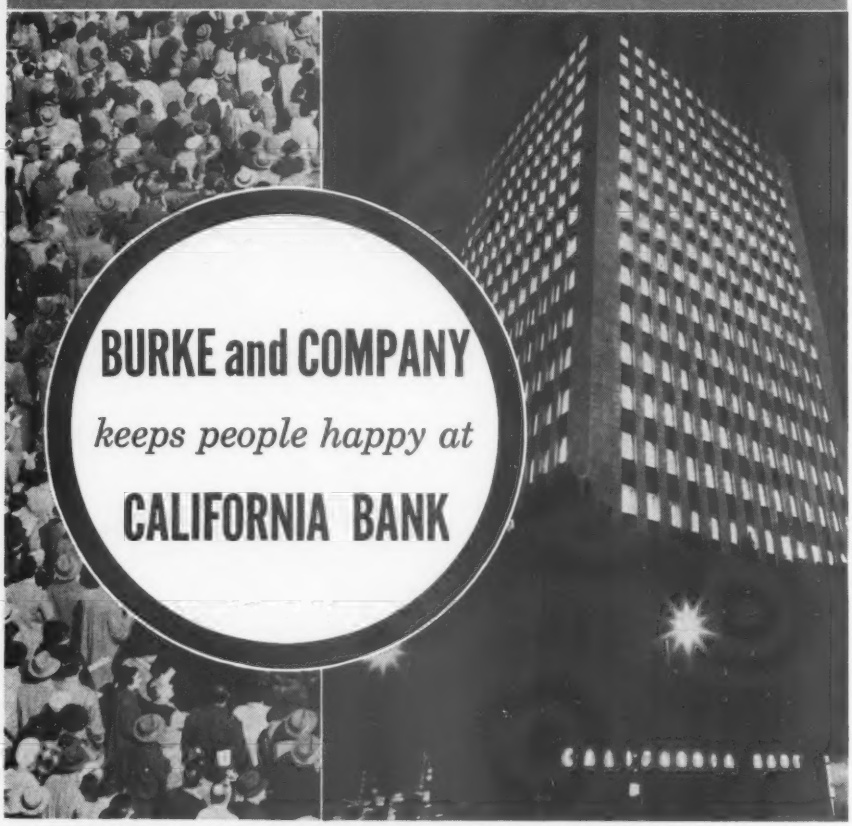
CHEMICO

CHEMICAL CONSTRUCTION CORPORATION
GAS SCRUBBER DIVISION
320 Park Avenue, New York 22, New York

Sales Representatives in:
Ferndale, Mich. • Chicago, Ill. • Los Angeles, Calif. • Houston, Tex. • Bartow, Fla. • Birmingham, Ala. • Millersville, Pa.

[For more information circle #21 on page 51 reply cards]

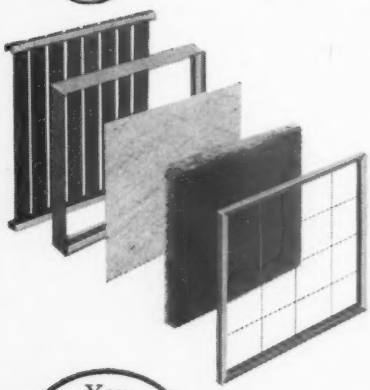
Where people gather...CLEAN PURE AIR is VITAL



ARCHITECT — Claud Beelman & Associates • GENERAL CONTRACTOR — C. L. Peck Construction & Realty Co. of Los Angeles • AIR CONDITIONING CONTRACTOR — Air Conditioning Company • MECHANICAL ENGINEERS — Kilpatrick & Company.

● Good customer relations require an atmosphere of clean, pure air for both patrons and employees. That's why in the new California Bank Building in Los Angeles ROTO AIRE replaceable media air filters, as well as both total and partial detention type gas and vapor adsorbers by Burke are being used.

ROTO*Aire*® FILTERS STOP AND HOLD DIRT!
ACTIVATED CHARCOAL FILTERS PURIFY AIR!



Here are advance design air filters and air purifiers that are highly efficient, effective and dependable.

They are readily adaptable to all new or existing installations.

They are available in a wide variety of sizes.

They may be operated at varying velocities and with various combinations of media.

The initial cost is low, but even more important . . . the maintenance cost is low.

You can specify ROTO*Aire*® PRODUCTS *with confidence!*

Write for Technical Data Bulletin and "Economic Analysis."

Selected Territories Available For Qualified Representatives

BURKE *and* COMPANY
2902 Hyde Park Blvd., Los Angeles 43, California

[For more information circle #22 on page 51 reply cards]

NEWS

(Continued from page 16)

● *Increased use of Glass.* Modern school design is calling for increasing use of large glass areas. While this reduces the cost of materials and labor, it actually increases heating systems first and operating costs.

● *Lower Sill Heights.* Unit ventilator manufacturers are reducing the height of their units from 32 in. and 30 in. to 28 in. (with plenum base). It is expected that sills will continue to drop in height during the next five years.

● *Lower Ceilings.* An 8 ft. 6 in. ceiling is no longer unusual in schools. The effect of this has been to create problems in air distribution. The air stream is deflected off low ceilings and does not follow the desirable distribution or circulation pattern which is needed for uniform classroom comfort.

● *No Room for Ducts.* Many engineers feel the general design of modern school buildings is such that it is increasingly difficult and expensive to use duct systems.

● *Curtain Walls.* Curtain wall construction is continuing to gain because its overall cost (and maintenance) is less than conventional construction and because it adds greatly to useable floor area. Curtain walls are prefabricated of porcelain-enameled steel and are shipped to the job-site complete with insulation, windows and trim. It is very difficult and often impossible to mount equipment on them.

● *Cluster or Campus Plan.* In essence, this plan provides for a multiplicity of 2 to 4 classroom units spread out over a wide area and connected to the main school unit only by covered walks. Its purpose is to eliminate waste space such as big corridors and to get the most useable teaching area per dollar.

If wet heat is used, it is necessary to run insulated mains in trenches from a central boiler to the many widely spaced building units. This system lends itself to individual horizontal or vertical forced air furnaces in each unit.

● *Adequate Fresh Air.* Considerable emphasis is placed on

(Please turn to page 22)

Take the cost out of fume and odor control!

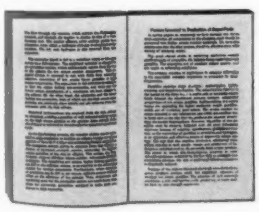
Modern advances of Catalytic Oxidation provide economical method for Air Correction

Heat and energy recovery from catalytic oxidation of fumes can often take much of the cost out of air control equipment. Catalytic Combustion, founded in 1950, has pioneered the development and application of catalytic oxidation systems for complete, economical elimination of industrial gaseous emissions which contribute to air pollution.

Catalytic's systems draw fumes from processing equipment, and pass the fumes through a circulating fan, discharging them through the catalyst element. With the catalytic system, "flameless" combustion takes place, and the heat needed is only 500° to 650° F., depending on the fume concentration. The resulting odor-free, color-free gases are then available for heat recovery, re-use in the processing equipment, or discharge to stack.

BTU's are valuable. Many fume streams have high potential fuel energy. In some processing applications, the recovery of this BTU value in dollars will pay for the equipment in a matter of months. Values too, in plant safety, employee morale, healthful, more pleasant working conditions, and improved community good-will can be measured in benefits to the firm employing truly effective fume and odor elimination.

Catalytic Combustion elements are built to standard sizes and complete systems are custom engineered to maximum effectiveness.



Learn the facts *about*
Heat Recovery and Air Correction...
write "Department A"
for our brochure.

CATALYTIC COMBUSTION CORPORATION
4725 Fourteenth Street • Detroit 8, Michigan
A SUBSIDIARY OF UNIVERSAL OIL PRODUCTS COMPANY

[For more information circle #39 on page 51 reply cards]

Angelica Uniforms and Victor Gloves Prevent "White Room" Contamination

Victor Monofilament Nylon Gloves

Angelica has been appointed the only distributor of Victor Gloves, the finest protective gloves made. Victor's non-contaminating gloves of monofilament nylon with plastic coated palms, have maximum touch sensitivity for precision operations. Victor Gloves Inc. collaborated with Bell Laboratories, Inc., in developing these gloves and Bell is currently using them in the assembly of select devices sensitive to physical and chemical contamination.

Other models include ambidextrous gloves and gloves for LOX parts.

Static-Free Dacura* Uniforms

Angelica's coveralls and frocks, of comfortable moisture absorbent Dacura (Dacron** polyester and rayon), are non-linting, acid resistant and static-free. The tight weave of continuous filament yarns resists passage of contamination from the skin or undergarments.

There is a complete "engineer designed" line of Dacura, Dacron, or nylon uniforms and accessories by Angelica and Victor Gloves Inc.

Mail this coupon to the nearest Angelica office below.

*Reg. T.M. H. P. Ogden Co.
**Reg. T.M. of Dupont

Send literature on White Room Uniforms and Gloves.

Name_____ Title_____

Company_____

Address_____

City_____ Zone___ State_____

Angelica®
UNIFORM COMPANY

1427 Olive St., St. Louis 3, Mo.
107 W. 48th St., New York 36, N. Y.
177 N. Michigan Ave., Chicago 1, Illinois
1900 W. Pico Blvd., Los Angeles 6, Calif.
317 Hayden St., N. W., Atlanta 13, Ga.

[For more information circle #23 on page 51 reply cards]

(Continued from page 20)

providing more fresh air in schoolrooms to provide adequate "natural cooling" in both cold and mild weather. Studies have shown that with 30 children in a class on a cold winter day, plus the trend to heavy, all-day use of electric lighting, the need is frequently for cooling rather than heating with principal purpose of heating being to kill downdrafts from large window areas.

- *Higher Temperature Drops.* To be watched is the interest shown in designing systems for higher water temperature drops (60°-80°). Objective is to lower system costs through the use of smaller piping, pumps, etc.
- *Air Conditioning.* Indications are that the air conditioning (mechanical cooling) of classrooms is becoming a major factor particularly in Texas, Arizona, and Central California. In these areas, the use of refrigerated cooling is definitely a factor in the better schools.

APCA To Hold 5th Annual Meeting

Air pollution experts from around the world are planning to join the Nation's leading air pollution control authorities at the 54th Annual Air Pollution Control Association Meeting June 11-15 at the Hotel Commodore in New York City.

The program for the Meeting will consist of an intensive review of all aspects of the Nation's air pollution control problem. More than 70 technical papers on specific problems will be delivered in 18 sessions. The keynote session topic will be "Air Pollution Standards."

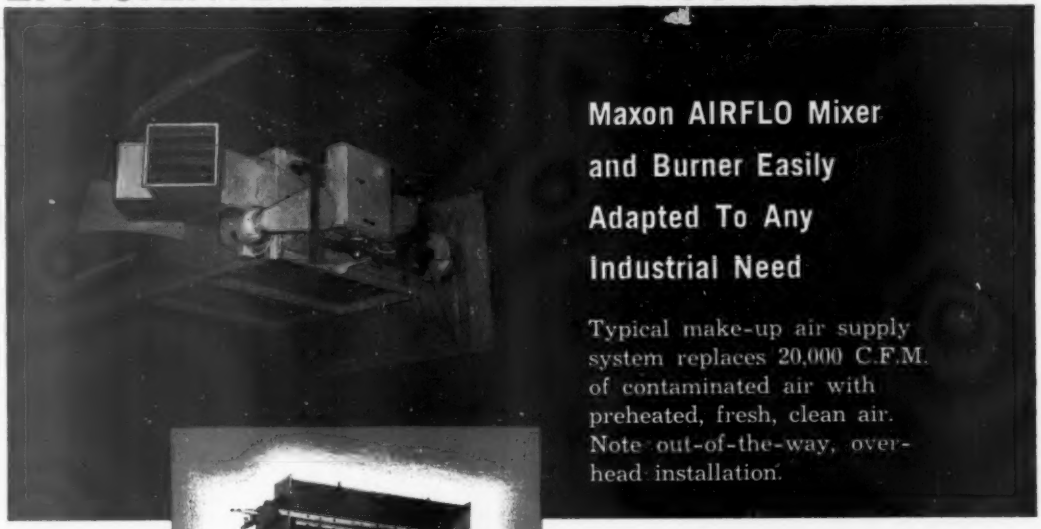
Among the other subjects to be dealt with during the technical sessions are community air pollution surveys, automotive exhaust research, industrial air pollution control, agricultural research, and zoning, planning, and administration for air pollution control.

For more meeting information contact Sheldon W. Samuels, 84 Holland Ave., Albany 8, New York.

Exhibit space information may be obtained from Mr. N. K. Post, Technical Representative, Industrial Applications, Airkem, Inc., 241 East 44th St., New York 17.

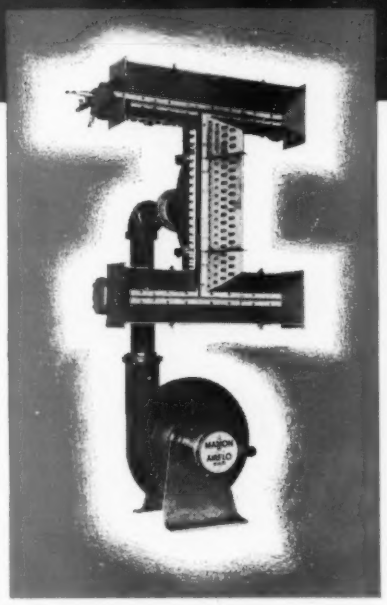
Now You Can Tailor Your Make-Up Air Supply System

EFFICIENTLY·DEPENDABLY·ECONOMICALLY



Maxon AIRFLO Mixer and Burner Easily Adapted To Any Industrial Need

Typical make-up air supply system replaces 20,000 C.F.M. of contaminated air with preheated, fresh, clean air. Note out-of-the-way, overhead installation.



ASSURES:

- Clean, odor-free combustion
- Smooth, dependable throttling over 25:1 range
- Even heat distribution across duct with all burners burning all the time
- Simplified single bank control

Standard units are available for systems from 4,000 to 200,000 C.F.M.

For complete information and application data see your Maxon Application Engineer or write to:

MAXON PREMIX BURNER COMPANY
MUNCIE, INDIANA

Ad-67

[For more information circle #25 on page 51 reply cards]

Precision operations like those at The Barden Corp. require rigid quality standards. Lint problems have been greatly minimized with uniforms of "Dacron".

FOR LINT-FREE UNIFORMS
it's DACRON® polyester fiber

Uniforms of filament "Dacron"* polyester fill a very real need where quality control is required. The smooth surface of filament "Dacron" *cannot* generate lint and thus contributes to White Room cleanliness. And "Dacron" does much more for uniforms—builds economy through long wear and minimum upkeep.

Uniforms of "Dacron" also lend themselves to either commercial or home laundering. So remember, efficient White Room maintenance is not really complete without the clean, fresh, lint-free benefits that uniforms of "Dacron" provide.

FOR SPECIAL ADVICE ON UNIFORMS, write: Uniform Counseling Service, E. I. du Pont de Nemours & Co. (Inc.), Textile Fibers Dept., Centre Road Bldg., Wilmington 98, Del.

DU PONT
REG. U.S. PAT. OFF.

Better Things for Better Living . . . *through Chemistry*

*"DACRON" IS DU PONT'S REGISTERED TRADEMARK FOR ITS POLYESTER FIBER. DU PONT MAKES FIBERS, NOT THE FABRIC OR UNIFORMS SHOWN.

[For more information circle #26 on page 51 reply cards]

Letters

(Continued from page 10)

use of air conditioning for employe comfort. To aid me in this effort, I would appreciate any related statistical or cost articles as well as examples of industrial application you can furnish.

Our product is research and development; consequently, I am particularly interested in information pertaining to research centers.

Your assistance in this matter is sincerely appreciated.

C. Costolo
Maintenance Supervisor
Bettis Site
Westinghouse Corp.
Pittsburgh, Pa.

Editor's Note:

Mr. Costolo was referred to our editorial and article in the February issue on the "Economics Of Factory Air Conditioning." Reprints of these articles are available to our readers.

Circle #172 on page 51.

"Economics Of Factory Air Conditioning"

Editor:

Would you please send me 225 reprints of Mr. Eugene A. Sloane's Editorial contained in the February, 1961, issue of AIR ENGINEERING. I would also like 225 reprints of the article, "The Economics of Industrial Air Conditioning."

H. K. Nickell
Owens-Corning Fiberglas Corp.
Toledo, Ohio

AIR ENGINEERING Index

Editor:

We would like to inquire whether "AIR ENGINEERING" publishes an annual index to the magazine's Contents, and if so, whether our firm's name could be placed on the mailing list?

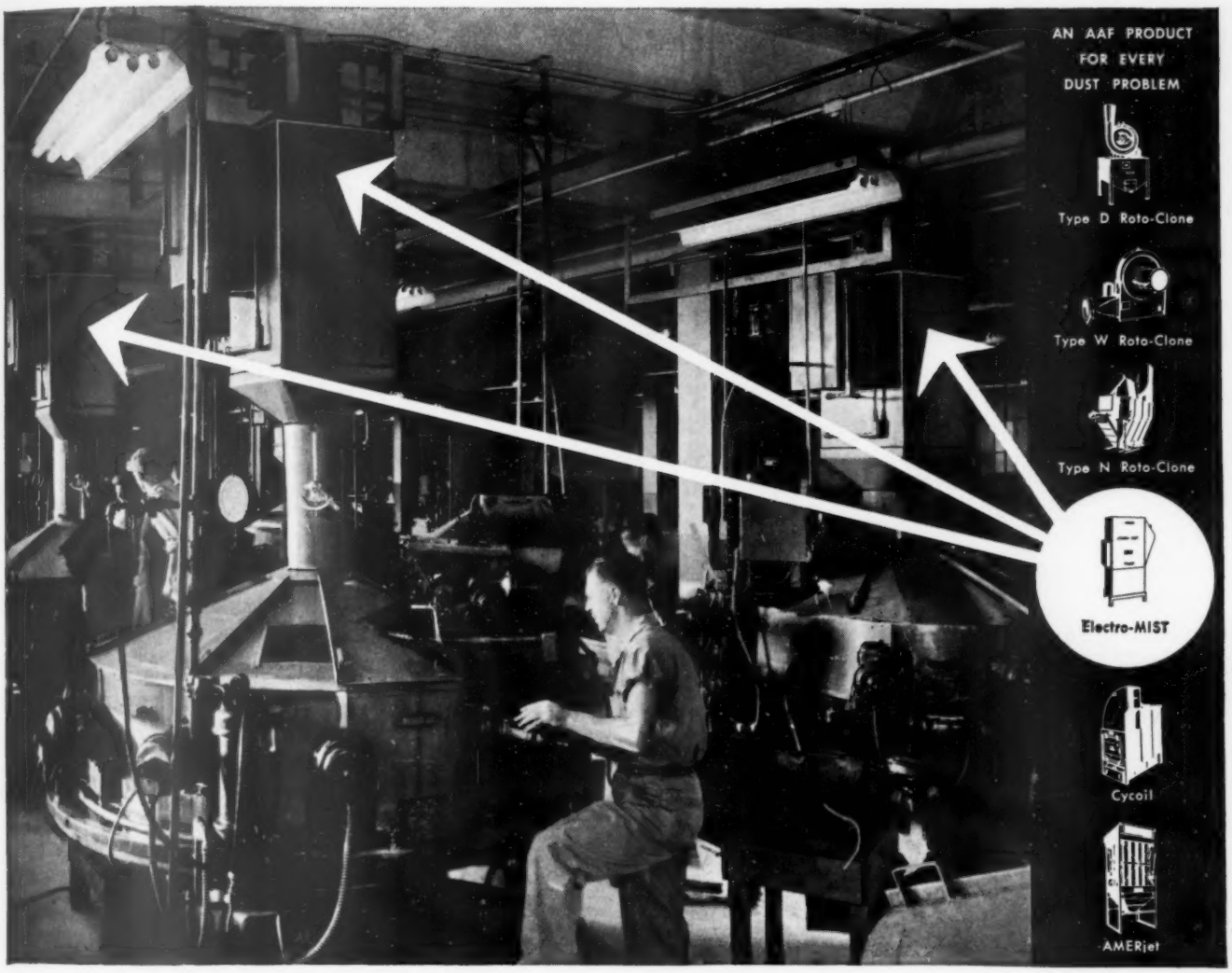
D. S. Chestnut
Ammons, McClure & Caldwell
Atlanta, Ga.

Editor's Note:

Extra copies of the 1960 AIR ENGINEERING *Index Contents are available at no charge to any of our readers.*

Circle #201 on page 51.

WET MACHINING



Eliminate oil mists with AAF's new increased-capacity *Electro*·MIST precipitators

● Wet machining need not be a greasy, oil-spattering, fire-hazardous process. AAF Electro·MIST electrostatic precipitators trap and collect oil mists, smoke and fumes right at their source.

AAF's new Electro·MIST is a combined exhauster and electronic collector, completely self-contained and self-cleaning in operation. Now designed in sizes from 1,000 to 3,000 cfm, these new models assure cleaner workroom air, regardless of the type wet machining operation. And three Electro·MIST precipitators, installed side by side, require only one motor and one power pack.

AAF's complete line of dust control equipment was application-developed, now challenges *any* metalworking dust problem. If your problem is wet machining oil mist, call your local AAF representative, or write for Electro·MIST Bulletin 251. Address Mr. Robert Moore, American Air Filter Company, Inc., 305 Central Avenue, Louisville, Kentucky.

AAF American Air Filter

BETTER AIR IS OUR BUSINESS

[For more information circle #27 on page 51 reply cards]

After installing air conditioning

Ship 'N Shore Gets 59% More Production

More evidence in the case for factory cooling is the 59 percent overall increased production for a total investment of 2.8 cents per manhour for cooling equipment, at Ship 'N Shore's Upland, Pa., plant.

by Eugene A. Sloane

AIR CONDITIONING IN THE FIERCELY COMPETITIVE garment industry is often as vital a tool of production as pressing or sewing machinery.

Ship 'N Shore, for example, one of the largest producers of quality blouses, has found that air conditioning their Upland, Pa. factory upped production by some 59 percent in the middle of their busiest season.

From a management standpoint, here's how Ship 'N Shore justifies factory air conditioning.

Sample blouses for the back-to-school market are made up and exhibited in May to department store buyers, who in turn place orders for the styles they think will sell best.

The back-to-school market is the largest of the four markets, the other three of which are Spring, Christmas, and resort. Production for the back-to-school market is necessarily at its peak in the hottest months of the summer, when adverse in-plant climate conditions work against achieving production efficiency from operators.

The plant had plenty of production facilities but because of high heat and humidity conditions could not get out adequate production during summer months.

Absenteeism was the biggest problem, followed by a slow-down in training programs. It takes about three months training to reach peak production, and some of the most promising employees would leave before that time.

Steam irons, operated at 14 psi, plus summer heat, made summer shutdowns frequent, cutting production during peak season, until air conditioning was added.

The pressing department, as might be expected, was the biggest problem. When production slows in pressing, other operations . . . cutting, sewing, inspection, sorting, packaging, shipping, slow likewise.

Steam from pressing irons, plus heat load from people, sensible heat from lights and irons, made working conditions such that absenteeism soared to as high as 40 percent of the work force.

On days when outside temperature rose to 90°F, plant often had to shut down entirely by noon, which alone accounted for 15 days lost production during summer.

An idea of the cooling load in the pressing department, which employs 70 out of a total of 170 workers in the engine plant, can be gleaned from the cooling apportioned to this department, as shown in Table 1 below. Note that of the total 191.5 tons, 70.5 is used by the pressing department, or about 1-ton per employee.

TABLE 1

Space	Sq. Ft.	Cfm	Tons
Cafeteria	1750	2,600	15.6
Shipping Department	9000	8,500	19.3
First Floor Office	2000	6,850	19.5
Pressing Room	4500	18,000	70.5
Second Floor Office	2000	10,100	24.9
N.E. Zone Packing	13,000	12,500	25.0
S.W. Zone Packing	4500	7,300	16.7
TOTAL	36,750	65,850	191.5

When management at Ship N' Shore decided to air condition the pressing department, they looked

hard at other departments and found, because absenteeism from these areas rose to about 15 percent of the total work force during summer, that the entire plant should be mechanically cooled. Spurred by steadily increasing sales, with a demand for prompt delivery, plans were pushed for complete factory cooling.

The consulting engineers found room for a 200-ton centrifugal water chiller in a wing next to the transformer station. A cooling tower for the chiller was erected at ground level opposite the machinery room.

The water chilling system supplies water from 55°F to 45°F at 415 gpm to cooling coils in the air handling units, which serve 38,750 sq. ft. of production and office space, through a ducted distribution system. Air handling units are ceiling-hung to conserve floor space.

Pressing department air distribution handles 18,000 cfm and requires chilled water when outside temperature exceeds 48°F. For other areas, chilled water is needed when outside temperature reaches 58°F, which means that cooling is required from June through October. During other months, outside air meets any cooling needs in the plant.

Results in terms of return on cooling investment have been little short of phenomenal.

- **Pressing department absenteeism reduced from 40 to 5 percent.**
- **Average efficiency increase of 10 percent per operator, proved by piecework studies.**
- **Substantial reduction in turnover in pressing department, from three out of ten who finished training before cooling, now six out of ten is the average completing their training period. Put another way, half of those who dropped before cooling could have qualified as top producing pressers had the plant been air conditioned.**
- **Absenteeism of other departments dropped from about 15 percent to an average of 3 to 5 percent. It's significant that these low absenteeism rates are maintained in a plant in which the work force is 95 percent female.**

Investment Analysis

Total investment per manhour amounted to 2.8¢. Total owning and operating costs of the air conditioning system are 49¢ per sq. ft. per year, broken down as follows: 27¢ owning (insurance, taxes, principal and interest amortized over 20 years) and 22¢ operating costs (about $8000 per year).

Other Benefits

To dollars-and-cents return, Ship 'N Shore adds these tangible benefits from their cooling system investment:

- **Competitive edge in hiring**
- **Improved morale**
- **No tardiness at lunch hour. (Employees prefer cooled plant cafeteria to outside restaurants.)**
- **Less garment smudging during handling, due to reduced perspiration.**

(Please turn to page 42)

Section of air distribution system. Completely air conditioned plant reduced absenteeism, raised production at this blouse plant.

Pressing department at Ship 'N Shore, which uses both steam and electric irons for highest quality finish.

Blouse inspection area. Piece work production records prove increase in employee efficiency after air conditioning.

Rework rate cut from 1200% to 20% by . . .

Super-Clean White Rooms For Precision Components

Part I

Polaris missile (at right) depends for its fantastic accuracy on guidance systems made to tolerances of ten-millionths of an inch. Guidance units must be assembled in dust-free conditions to maintain missile accuracy. Author tells how Autonetics designs and uses "White Rooms"

by W. R. Jerome*
Group Leader, Productibility Study Group
Autonetics Division
North American Aviation Co.

DUST CONTROL IS A PROBLEM that concerns everyone from the housewife with her dust-cloth to the laboratory technician with his microscope. It is an ever-present, and, in this age of miniaturization, an ever-increasing factor of precision assembly.

Autonetics designed and built the Mark II Inertial Navigation System that is installed in the George Washington, the same type Autonetics inertial navigation system that guided the nuclear submarines Nautilus and Skate on their historic voyages under the ice cap of the North Pole, voyages of 1800 nautical miles traveling for four days and nights completely submerged. This type of blind navigation calls for the finest of precision instruments – *instruments with manufacturing tolerances of ten millionths of an inch.*

Although Autonetics has facilities scattered over a forty mile radius, the main plant is located at Downey, California, roughly 15 miles southeast of Los Angeles. A corporate division of North American Aviation, it is one of the largest and most advanced facilities in the world designed exclusively for the research, development, and volume production of precision

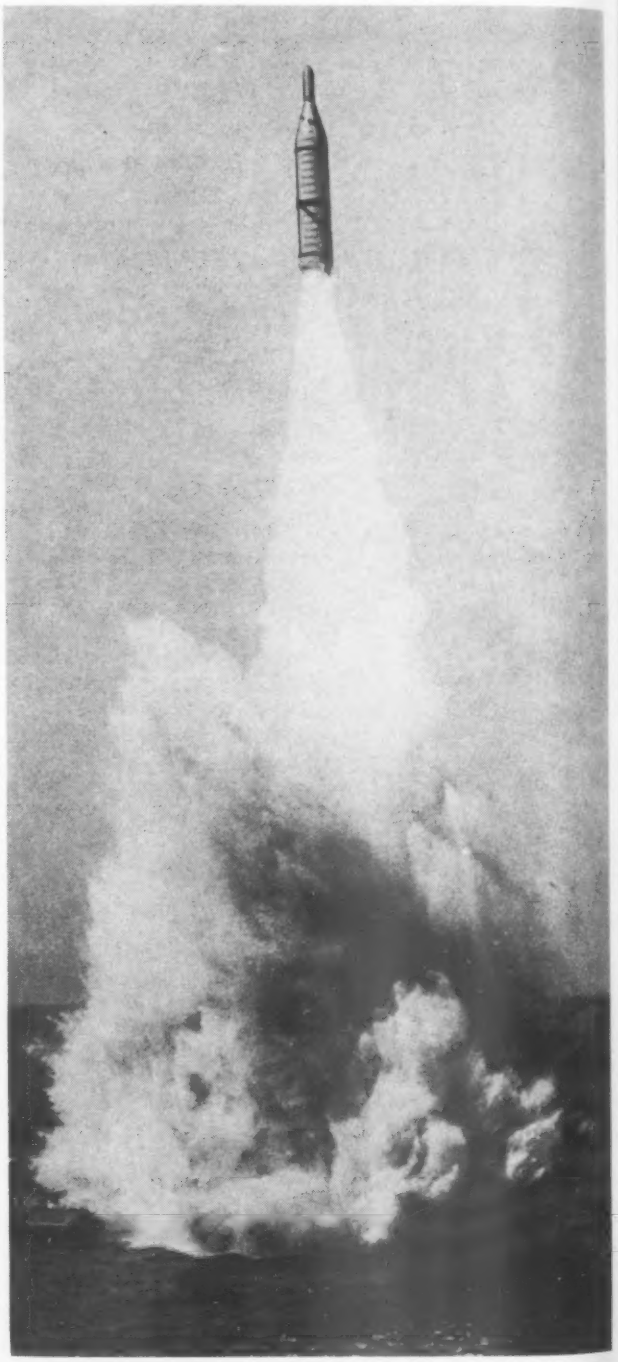


Fig. 1: A view of the Polaris launch during the firing of the Polaris missile from the submerged nuclear submarine, the USS George Washington.

electromechanics. At the present time we have over 22,000 employees, spread over 2,000,000 sq. ft. of floor space.

Some of Autonetics facilities include: individual development laboratories for each design group . . . a comprehensive flight-test facility with a wide range of aircraft . . . a continuous-process etched-circuit board line for 12,000 boards per week . . . an unusually complete environmental laboratory for testing resistance to temperature, humidity, altitude, salt and fog, spray, sand and dust, rain, sunshine, fungus, shock, acceleration, and radio-noise interference. Perhaps, most important of all, Autonetics has excellent dust controlled facilities.

While Autonetics makes a variety of products, our major product lines fall into four categories:

- **First, Inertial Navigation Systems, such as the Mark II for the George Washington and other nuclear submarines, and the guidance systems for MINUTEMAN and Hound Dog missiles.**
- **Second, Computers and Data Systems, including the Army's FADAC: Field Artillery Digital Automatic Computer.**
- **Third, Armament and Flight Controls—NASARR radar for the F104 Shooting Star fighter-bomber, and the MG-4 fire control system.**
- **Fourth, Industrial Products, which includes RECOMP II, a desk-top general purpose computer for commercial use.**

To produce these products with their precision components and assemblies, Autonetics has had to establish dust-controlled areas. Ordinary air has about 30,000 particles per cubic foot which are larger than 0.5 microns. Factory air has about 50,000 particles per cubic foot larger than 0.5 micron.

These conditions are obviously impossible to work in when fabricating products which require precision components and assemblies – tolerances as close as 10 millionths and clearances on moving parts as close as 50 millionths of an inch.

Consider these tolerances as opposed to the thickness of a human air – .003 of an inch in diameter, or to a particle of face powder, which is the same size. The smallest particle visible to the human eye is 30 to 60 microns, or .001 to .002 of an inch.

Precision assembly calls for special assembly areas – areas of controlled humidity, dust particles, and temperature. A 20° temperature change will cause a 10 in. aluminum part to change size by more than .002 of an inch. Precision tolerances obviously cannot be obtained or held outside of a constant temperature room other than by a trial and error method which is unreliable, time consuming, and costly.

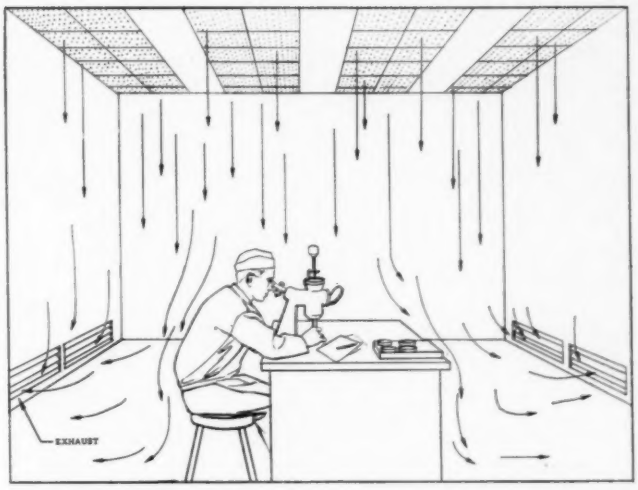


Fig. 2: Schematic drawing of a typical side view showing air flow in a dust controlled room.

Autonetics has – at the present time – four dust-controlled areas which have a combined total floor space of 43,000 square feet, or about one acre of dust-free space. This includes 17 assembly or working rooms, plus paper workrooms, man-cleaners, parts-cleaning rooms, locker rooms, and reception rooms for 375 first shift personnel.

In these rooms we do the mechanical assembly and repair of precision gyros, velocity meters, accelerometers, inertial distance meters, and computer memory units. Also, gyro filling operations, cleaning, inspection, reclassification and storage of precision bearings, and their assembly into designed units and similar precision operations.

All air enters the room through a perforated false ceiling (Fig. 2) which diffuses the air gently downward; exhaust air leaves the room three inches above the floor all around the room. The slow downward motion of the clean incoming air tends to keep the dust down below bench level. One piece of electrically grounded linoleum covers the floor. All painted surfaces are finished with epoxy paint.

Lights are flush in the ceiling and give 100 diffused foot candles at the bench level.

Fig. 3 shows the floor plan of a dust-controlled area and the air flow. All dust-controlled areas are slightly pressurized so that any air leakage through the air locks is outward. The innermost room (the cleanest one) carries the highest pressure. The air pressure decreases room by room to the hallway, locker rooms, man-cleaner and reception room to normal pressure outside the reception room door.

If you were to enter the areas (Fig. 4) you would open the door into the first air lock (reception room)

(Please turn to following page)

**Mr. Jerome is a graduate manufacturing engineer, University of Minnesota, a graduate of the U.S. Naval Academy with the rank of Commander in the inactive reserve. He designed and supervised construction, operation and maintenance of North American's first "dust-free" room in 1953 and has been active in this work since. He is also an industry consultant in Dust-Free room design. In his present capacity with Autonetics he is working on advanced manufacturing methods for high-volume production operations two to three years in the future.*

(Continued from preceding page)

where a noticeable outgoing breeze of air lightly dusts you off. You are walking on corrugated mats and tac mats. Coats and personal effects are left in this area. If you've been approved by the Plant Superintendent, Plant Manager, or Vice President, the door to the next area is unlocked for you by the receptionist. If approval hasn't been obtained from one of these three men, you don't get in.

Assuming you have got past the controlled door with its accompanying outgoing breeze, you are requested to use the shoe cleaner and have the top, sides, and bottoms of your shoes brushed and vacuumed. Washroom and drinking facilities are provided in this area.

The next air lock is a man-cleaner where you are air-showered for 30 seconds from top to bottom, with a dry, clean blast of 30 mile-an-hour wind. Next you are in the fourth air lock, the locker room, where you don a nylon or orlon lint-free smock and head cover. These garments are vacuumed clean daily and washed with special handling every three days. These are packaged in sealed plastic bags and stored only in this area.

Ideally you would next pass through to a second man-cleaner, the fifth air lock, which would be the same as the first man-cleaner, and then into the sixth air lock which is a "glass" hallway with doors leading directly to the dust-controlled assembly areas.

In the assembly area itself, workbenches are aligned end-to-end across the room, with utilities piped in under the bench, so that the layout is semi-permanent. The electrical conduit is "Wire Mold" No. 3000 and will carry up to 20 different kinds of electricity. The wire can be broken at the end of any bench – as can the vacuum, nitrogen, helium, and hydrogen lines. All of these have take-offs for each bench.

Air Conditioning System

The air conditioning system in the dust-controlled rooms operates 24 hours a day, 7 days a week. It provides a plus or minus ½° temperature, a relative humidity between 25 percent and 40 percent, and a dust concentration below 10 particles over 0.5 micron in size per cubic foot. Pressure in the controlled areas is kept at about ¼ in. of water above the pressure in adjacent areas.

The air filtering is done by two to three banks of filters. The first bank of filters is 10 or 12 gage mechanical type; the second bank is an automatic (or self-cleaning) electric precipitation; the third bank is a sub-micron filter. To this system a water wash or mechanical, 85 percent filter may be substituted for the electric precipitation and, in some cases, it may be substituted for both the first and second banks.

Filters are used at about 80 percent of their rated capacity. They are changed when they are dirty as

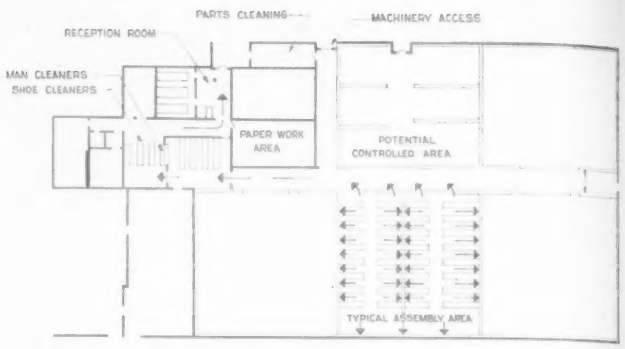


Fig. 3: The floor plan of a dust controlled area and the air flow. All dust controlled areas are slightly pressurized and air leakage through air locks is outward.

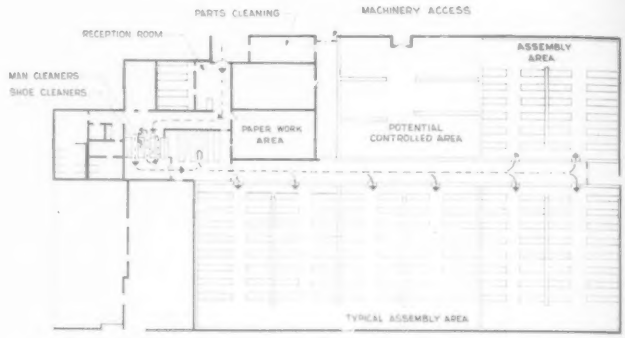


Fig. 4: Schematic drawing of a dust controlled area showing traffic flow.

determined by the pressure drop across the filter. The pressure drop is measured with a permanent type installation of a differential pressure gage across each bank of filters.

If the air conditioning system fails, or has to be shut down, the room must be evacuated until the system has again been operational for at least one hour, the room mopped out, and the dust count down to normal. No standby equipment is considered necessary.

The air conditioning system must maintain a positive pressure in all rooms and air locks. Pressure is maintained by means of weighted louvers in the doors and pressure-regulated electrically-operated shut-off vanes in the return air ducts. The room should be able to seal itself automatically closed in case of breakdown. About 25 percent fresh "make up" air is continually added and a complete air change is made every six minutes. Any exhaust system in the room must be compensated for by an increase in "make up" air. Powered exhaust systems in the dust-controlled room, such as are normally used with a cleaning hood, should be held to a minimum; they are probably unnecessary since the room is pressurized.

Our dust-controlled areas are classified alphabetically in a descending scale, as shown in Table I. Numerous Autonetics drawings and specifications

delineate these classifications, but, for our purposes, they fall into these seven categories.

1. **Class "A" Dust Controlled Area.** This is a metal and glass-enclosed cabinet within a Class "B" room. Maximum dust-free conditions prevail. The equipment supporting the cabinet is capable of three-tenths of a micron filtration with over 99 percent efficiency. An example of a Class "A" area would be a steri-shield cabinet inside a dust controlled room.

Dust counts are taken every four hours of occupancy, or oftener. At no time when the area is being used for fabrication or assembly of precision parts, shall the dust count exceed 200 particles per cubic foot over 0.5 micron in size.

2. **Class "B" Dust Controlled Area.** This area requires maximum dust-controlled conditions obtainable with commercially available equipment and materials. Precautions include using airlocks, lint-free outer clothing, two or three banks of air filters, controlled entry, ball-point pens and dust-and-lint free paper, pressurized rooms, and every practical means to further reduce dust concentration on a continuous basis.

Dust counts are taken at least once every 8 hours of occupancy. Maximum dust count must not exceed 200 particles per cubic foot larger than 5.0 micron in size.

3. **Class "C" Dust Controlled Area.** This is an area of good dust-free conditions. The same requirements as Class "B" dust-controlled area exist except that filters capable of only five micron filtration are required.

Dust counts are taken at least every other working day. Maximum dust count is not to exceed 500 particles per cubic foot larger than 5.0 micron.

4. **Class "D" Dust Controlled Area.** Some dust-controlled conditions exist here. These conditions are obtainable with filters capable of 10 micron filtration and with the enforcing of extra good housekeeping

(Please turn to following page)

TABLE 1—ROOM CLASSIFICATIONS

Dust—Humidity—Temperature Controlled Areas and Combinations

Class Area	Particle Count Per Cu. Foot Not to Exceed	Particle Size (Micron)	Temperature Controlled At (F)	Temperature Tolerance (F)	Relative Humidity (Percent)	Air Locks Cleaner etc.	Special Outer Garments	Special Regulations	Remarks
A	200	0.5*	70			Yes	Yes	Yes	Class A—Dust Controlled Area
B	200	5*	70			Yes	Yes	Yes	Class B—Dust Controlled Area
C	500	5*	70			Opt.	Opt.	Opt.	Class C—Dust Controlled Area
D	1000	10*							Class D—Dust Controlled Area
T-1				±1					Class M—Close Temperature Controlled Area
T-5				±5					Class N—Temperature Controlled Area
H					Below Max. of 50				Class O—Maximum Humidity Controlled Area
AHT-1	200	0.5	70	±1	Below Max. of 50	Yes	Yes	Yes	Dust, Maximum Humidity and Close Temperature Controlled Area
BT-5	200	5	70	±5		Yes	Yes	Yes	Dust and Temperature Controlled Area
BHT-5	200	5	70	±5	Below Max. of 50	Yes	Yes	Yes	Dust, Temperature, and Maximum Humidity Controlled Area
AT-1	200	0.5	70	±1		Yes	Yes	Yes	Dust and Close Temperature Controlled Area

*And Larger.

(Continued from preceding page)

practices. Dust count does not exceed 1000 particles of 10 micron size or larger per cubic foot. Dust counts are taken at least once a week.

5. Class "T-1" Area. The "T-1" signifies that in this area the temperature is controlled so that it does not fluctuate more than ±1° from the mean level for which the system is adjusted. A continuous recording of temperature is maintained, with the recording equipment checked monthly.

6. Class "T-5" Area. The "T-5" signifies that the temperature is controlled here so that it does not fluctuate more than ±5 F from the mean level for which the system is adjusted. The other requirements are the same as for room "T-1."

7. Class "H" Area. The "H" standards for "Humidity." The relative humidity is maintained in a Class "H" area below a maximum of 50 percent. The humidity is continuously recorded and recording instruments are checked monthly for accuracy.

Sources Of Dust

The real problem of dust comes not from the air which is circulated into the dust-controlled area, as this has a dust count of less than 10 particles 0.5 micron size or larger, but from the constant traffic in, about, and out of the room.

In any one of our A-, B-, or C-class dust-controlled rooms, we can show nearly "O" dust count when the room is empty of personnel, and a dust count of only 50 when there are five to six people in the room. But occasionally we have to shut down a room because we go over our allowable maximum of 200 particles. Why? Because of the dust from the people and the parts coming into the area. This is Autonetics and every manufacturer's major problem in a dust-controlled room.

Dust Prevention Methods

The parts half of this problem appears to be solved. Parts and their containers are pre-cleaned outside of the dust-controlled area with ultrasonic vapor degreasers or chemicals, using a spray or brushes as necessary. Only after this cleaning are the parts packaged for the dust-controlled room. Parts, tools, and other equipment being moved into a dust-controlled area are specially processed in accordance with rigid Autonetics specifications.

When the parts have completed this preliminary cleaning and packaging, they are taken to the dust-controlled area and placed from the outside into a special double air lock (Fig. 5). All communication is conducted via inter-com to prevent unnecessary passage into the dust-controlled area. The double windows are never both opened at the same time.

From here they pass into an inside parts wash or preparation room where they and their containers are thoroughly vacuumed (Fig. 6). Some parts are further washed with a filtered naphtha or alcohol spray and protected as necessary. All parts which are not for immediate use are stocked in covered containers for the next day's use.

A third cleaning may be administered in the dust-controlled room itself. A Freon TF ultrasonics or a vapor degreaser may be used on some parts for final cleaning and to remove fingerprints immediately prior to cementing. All precision parts are closely inspected with a microscope just before final assembly for any remaining dirt or dust.

So the parts half of the problem is reasonably well controlled. But how do you lick the other half of this problem – the personnel? We all have people who have to come and go – there are some filtering problems even the dust controlled areas can't handle ▲▲

Next month Mr. Jerome will discuss personnel training, dust count procedure and the results of constructing the described super-clean areas.

Fig. 5: Inter-com system used for all communication in dust controlled areas to prevent unnecessary passage into the areas. The double windows are never both opened at the same time.

Fig. 6: After parts have been thoroughly vacuumed they are further washed with a filtered naphtha or alcohol spray and protected as necessary.

550° Hot Gas From Electric Steel Melting Furnace Cleaned By . . .

Glass-Fabric Baghouse

by Harold Schubert
Plant Engineer
Bethlehem Steel Company

IN THE RECENTLY COMPLETED multi-million dollar expansion program at Bethlehem's Seattle Plant was the elimination of five old 50-ton open hearth steelmaking furnaces and the installation of two new 100-ton electric arc furnaces. These are top-charged with cold steel scrap and have 20-ft. diameter shells.

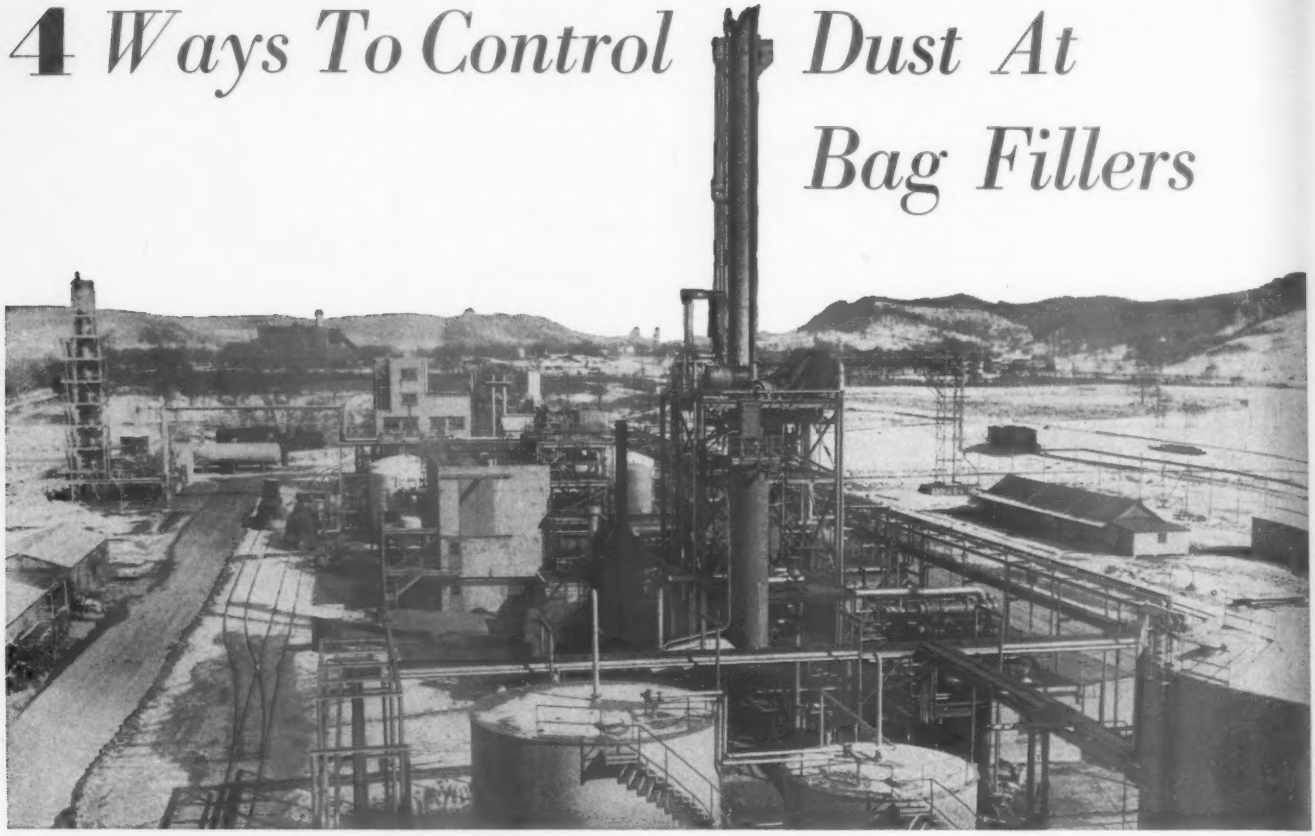
Types of steel produced are rimmed, semi-killed and killed. Grades cover the full range of plain carbon as well as some low alloy steels. Three, and, at times, four charges are required for the usual heat, the first charge weighing about 50 tons and subsequent charges being successively smaller. Each furnace is tapped approximately every four hours.

Shortly after the first electric furnace was placed in operation in 1958, it became apparent that very effective dust and fume removal from the furnace gases was necessary.

During the melt period analysis showed that fume-dust emissions contained non-hygroscopic solid particles and that the average grain load varied from

(Please turn to page 42)

4 Ways To Control Dust At Bag Fillers



View of American Cyanamid Co.'s new aniline manufacturing facilities at Willow Island, W. Va. Plants such as these require careful design of ventilating systems to maintain employee health.

By William V. Andresen
Chief Industrial Hygienist
American Cyanamid Co.

Complete data for ventilation of bagging and weight adjustment operations employing auger, impeller, fluidized, and belt type packers.

MANY BAG FILLING OPERATIONS utilize valve type bags which are placed onto a filling spout or filling tube on a bagging machine. During the bagging operation, dust may be evolved from the bag when air in the bag is displaced and may also be created by product spilling from the bagging spout after the bag is removed. Several types of valve pack bag packers are manufactured. One type employs an augar or screw installed in the spout. Material is conveyed into the bag by the rotating action of the screw.

The impeller type packer employs feeder blades on a shaft. These blades force material through the filling tube into the machine.

A relatively new fluidized type packer uses air to fluidize the material to be packed to the point where it flows through the filling tube.

In the belt type packer, material is fed onto an endless belt which presses against a grooved pulley. The pulley rotates at a high speed and the material is discharged at a tangent to the pulley through the filling tube.

Control Air Volume

Some manufacturers of augar, impeller and fluidized packers either supply hoods or recommended hood designs and specify control air volume. These designs usually provide satisfactory control of the dust caused by the displacement of air from the bag but do not effect control of dust caused by spill or drippage from the filling tube. Where highly toxic

***WILLIAM ANDRESEN** is chief industrial hygienist for the American Cyanamid Co. A graduate engineer, he is vice chairman of the Bergen County, New Jersey air pollution control committee. He is also a delegate from the National Safety Council to the American Standards Association committee Z-9 on industrial ventilation. He is a member of the American Industrial Hygiene Association.*

or irritating dusts are packed, it is advisable to use a hooded enclosure such as is shown in sketch #1. The enclosure will provide control of the dust escaping from the bag as well as containing spillage and drip from the filling tube. A control velocity of 125 fpm will usually provide satisfactory control. The hood design shown in the sketch shows a drawer in which spilled materials are contained during bagging operations. The drawer provides an easy way to remove material from the hood.

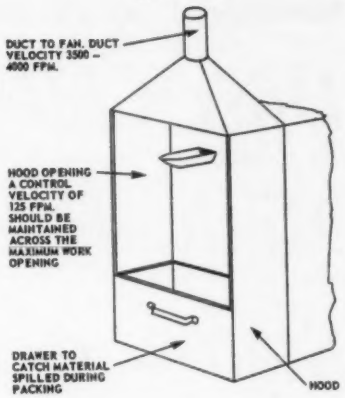

DUCT TO FAN. DUCT VELOCITY 3500 – 4000 FPM.
HOOD OPENING A CONTROL VELOCITY OF 125 FPM. SHOULD BE MAINTAINED ACROSS THE MAXIMUM WORK OPENING
DRAWER TO CATCH MATERIAL SPILLED DURING PACKING
HOOD

Fig. 1: Hood for auger, impeller, and fluidized packers. Hood is used on single packers and a drawer to catch spilled material is provided. Control velocity of 125 fpm should be maintained across hood opening.

Belt Type Packer

Control of dust created during bag packing with a belt type packer is often accomplished by exhausting air directly from the packer housing. The manufacturer of the packer usually specifies the control air volume required and this volume usually effects satisfactory control. However, again there is no provision for control and containment of spilled material. Sketch #2 shows a hood design which combines ventilation of the packer housing with a hood enclosure to provide control of spilled material. This design is especially desirable when packing of extremely irritating or toxic products is performed. Although not shown in the hood sketch, a tray or drawer to contain and collect spilled material may be included as part of the design. A control velocity of 125 fpm will usually provide satisfactory control of dust. The air volume utilized for exhausting the packer housing may be considered as part of the volume necessary to provide the hood enclosure face velocity.

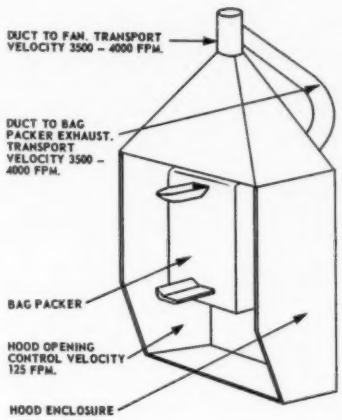

DUCT TO FAN. TRANSPORT VELOCITY 3500 – 4000 FPM.
DUCT TO BAG PACKER EXHAUST. TRANSPORT VELOCITY 3500 – 4000 FPM.
BAG PACKER
HOOD OPENING CONTROL VELOCITY 125 FPM.
HOOD ENCLOSURE

Fig. 2: Typical hood enclosure for the control of dust during bag packing from belt packers. A drawer may be provided to contain spillage.

Bag Weight Adjustment

In many valve bag packing operations, it is necessary to make final manual bag weight adjustment operations either to insure that the customer gets the weight of product he is paying for or in the case of high cost products that the bags are not overweight.

During weight adjustment operations, dust is liberated from the container in which material for adjustment is contained and from the bag itself.

Sketch #3 shows a hood enclosure which may be utilized to control dust from both of these sources. The bag is placed upon an adjustment scale with the valve extending into the hood enclosure. A control velocity of 125 fpm will usually provide satisfactory control of dust liberated during weight adjustment operations.

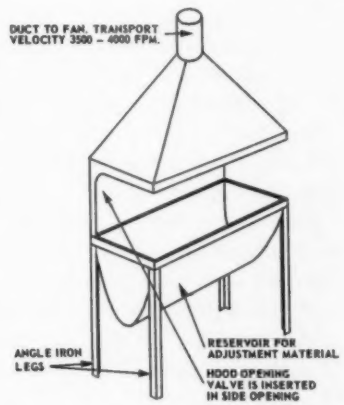

DUCT TO FAN. TRANSPORT VELOCITY 3500 – 4000 FPM.
ANGLE IRON LEGS
RESERVOIR FOR ADJUSTMENT MATERIAL
HOOD OPENING VALVE IS INSERTED IN SIDE OPENING

Fig. 3: Typical hood for control of dust during valve bag weight adjustment. Scale is located next to open side of hood and the bag valve is inserted into the side opening. Weight adjustment is made from the reservoir. A control velocity of 125 fpm should be maintained across the hood opening.

Shot Type Ventilation

Slot type ventilation will also provide satisfactory control of dust from bag weight adjustment operations. Slot hood are provided for the bag valve and for the container in which material for adjustment is stored. The hoods should be located as close as is feasible to the operations. The control air volume requirement may be determined by multiplying the area to be controlled by 150. Sketch #4 shows the application of slot hood ventilation. ▲▲

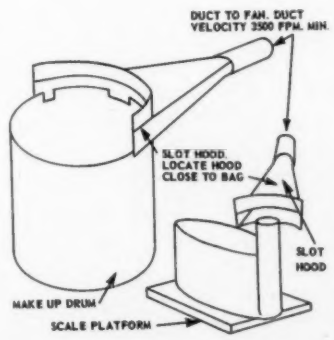
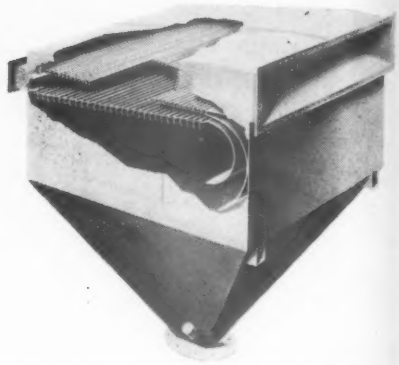


Fig. 4: Alternate method for control of dust liberated during bag check weight operation. Slot type ventilation is used for control at both the bag and make up drum. Hood at bag should be located so that the bag may easily be positioned close to it. Control volume required = 150 × area to be controlled.

Practical ways to handle . . .

Dust Collection Methods For Steam Power Plants

Part II



Low resistance mechanical collector used in stoker-fired applications. Particles larger than 43 microns are readily captured. Particles in the 3 30 micron range receive 60 percent collection.

Specific data on the characteristics of flyash particle size and abrasiveness; combining mechanical and electrostatic dust collection units; and the cost factors to be considered when doing so.

by Gregory Gould*
President
Fuel Engineering Co.

IT HAS BEEN FOUND as a rule size distribution of flyash closely follows the so-called logarithmic probability law, which means that there is a predominently greater proportion of fine than coarse particles. Chart No. 1 shows some typical particle size distributions for flyash from various types of combustion equipment. From this chart it is readily apparent that cyclone firing and pulverized coal firing produce finer flyash than when coal is burned only partially in suspension as on a spreader stroker, or on grates as with underfeed and chain grate stokers.

The characteristics of particles of different size in flue dusts tend to exhibit variations that are significant. Flyash under 20 to 40 microns in size tends to form stable agglomerates and to adhere to surfaces. Flyash coarser than this does not and its presence tends to reduce cohesive and adhesive properties. It is the finer flyash which tends to cause plugging in centrifugal collectors and it is the finer flyash which tends to be difficult to remove from the plates of electrostatic precipitators.

There is a rough correlation between carbon content and coarseness of flyash in any given plant. Coarse flyash and high carbon content go together. The effect of high carbon flyash in an electrostatic precipitator has already been noted.

The efficiency of centrifugal collectors which depends on inertial forces to separate dust from the gas generally falls off sharply below about 15 microns. Observation of the typical flue dust size distributions in Chart No. 1 will show that for the curves presented, 65 percent of the dust from this cyclone furnace would not be collected effectively and that about 40 percent of the flyash from this pulverized coal unit would fall in this same region.

The specific gravity of flyash is related to particle size as well as to its structure and carbon content. Larger particles which tend to run high in carbon usually have apparent specific gravities less than one. Finer particles will have specific gravities ranging from 1.5 to 3, while very small particles may run well over 4. This large variation in density between particles tends to produce stratification of the dust in gas streams. The bulk density of flyash varies from about 30 to 50 lbs./cu. ft.

Optical properties of dusts are also related to particle size. Fine particles scatter light in directions other than that of the original beam and will obscure or reduce a light when observed through a plume of smoke. The light scattering and obscuring potential increases with specific surface and specific surface increases rapidly with decrease in particle size. *Thus fine particles make a smoke plume appear much denser than coarse particles.* It is for this reason that removal of particles larger than 20 microns has little effect on the appearance of a plume. It is this phenomena which tends to make the effluent from a cyclone fired boiler chimney look worse than it really is. It has been found that stack gases must not contain more than about 0.05 lb. of dust per 1,000 lbs. of gas if they are to appear essentially clear.

Abrasiveness

Flyash is a fairly abrasive material. Many of the early reinjection

*Mr. Gould is a registered professional engineer in N.Y., a member of: Air Pollution Control Assoc., Amer. Soc. for Testing Materials, Nat'l. Soc. of Professional Engineers, Amer. Soc. of Mech. Engineers, N.Y. State Society of Professional Engineers, Inc.

systems on spreader stokers experienced severe erosion at elbows which sometimes failed in a matter of weeks. This abrasiveness also causes deterioration of the tubes in centrifugal tubular collectors. Abrasiveness apparently is closely related to the quantity of silica and coke in the flyash. White cast iron has been found by one manufacturer to be a reasonable compromise between cost and resistance to abrasion as a material of construction for tubular centrifugal collectors.

Combining Mechanical and Electrostatic Units

Design advances in electrostatic precipitators in the past five years has reduced many of the former advantages of combined electrostatic and mechanical collection systems. Flat plate electrostatic precipitator designs did not retain high carbon flyash very well, with the result that puffs from the stack were a nuisance during soot blowing and collector plate rapping operations. Precipitator efficiencies were relatively low on units which, for one reason or another, had high carbon flyash. Pocket electrodes and continuous rapping have largely circumvented these problems. Another justification for series installations was that should the electrostatic precipitator become de-energized for any reason the mechanical collector would still remove a major portion of the flyash. Sectionalized design plus more reliable rectifiers have overcome this problem to a large extent.

The removal of particles over ten to twenty microns in size from the flyash entering an electrostatic precipitator tends to result in build up of flyash on the discharge wires. The ionizing voltage available for an electrostatic precipitator will produce corona discharge only from wires up to a certain maximum diameter. The accumulation of dust on high voltage discharge wires can build up the diameter to the point where corona will cease. This requires the use of high voltage rappers as well as collection plate rappers, which adds to the cost of the electrostatic precipitator construction. In addition, increased fan power required to operate a series combination has to be taken into account in evaluating a straight electrostatic precipitator installation, versus the alternative series combination.

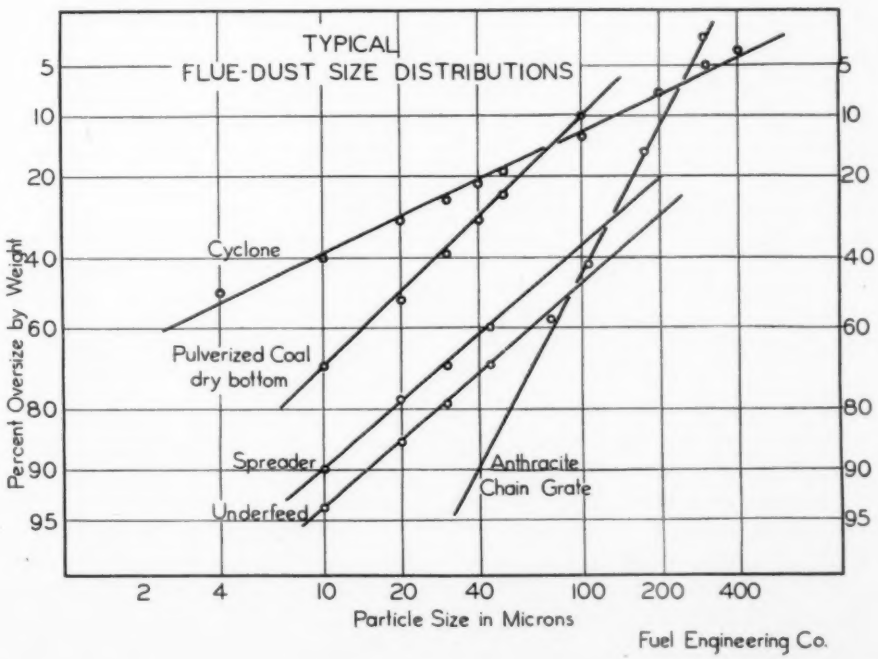
Where maximum efficiency is desired the efficiency of the cyclone collector in relation to particle size is a factor. If the mechanical unit is placed first it has the opportunity to operate on the entire spectrum of particle size and will develop its full potential for that particular dust. The electrostatic unit which is not so sensitive to particle size will still develop close to its maximum efficiency on the dust that remains. On the other hand if the electrostatic unit is placed first, the mechanical unit must operate on low concentrations of partially classified dust and its maximum efficiency will not be developed. Where series arrangements are indicated for steam plant work a mechanical unit ahead of the electrostatic unit is generally preferred.

Costs

The cost of collectors and precipitators can add appreciably to the initial capital outlay for a plant. There are so many variables in fuel selection, combustion equipment and collection equipment that no pat answers can possibly be formulated for the minimum cost to own and operate. Furthermore, revenues from sale of collected material may be possible with certain arrangements and not with others and such considerations could easily tip the balance in favor of a more expensive initial investment.

Each individual case must be analyzed and all the alternatives evaluated. On existing installations many alternatives are automatically eliminated because of limitations imposed by the existing circumstances. This may simplify the number of alternatives that will have to be studied despite the fact that corrective measures will probably cost more than would be the case with new construction.

The cost of mechanical collectors will generally range between 12¢ and 20¢ per cfm delivered but not installed, while electrostatic precipitators will range in cost between 30¢ and 75¢ per cfm delivered, the lower figure applying to the larger units. Series mechanical and electrostatic installations often run well over $1.00 per cfm. Mechanical collectors for small boilers of 100 hp and under may also approach this latter figure. Installed costs on new construction will run about 1.5 times delivered costs. On existing plants, installed costs can double and triple basic equipment costs. Because of this, the flue gases from existing installations should be carefully sampled and all the characteristics of the flyash accurately determined so that designs may reflect the specific requirements of the plant and thus minimize costs. ▲▲



What you should know about

Electrical Requirements Of Electrostatic Precipitators

Factors considered include . . . the selection of precipitator switchgear, instrumentation of precipitator equipment, and the economics of achieving the efficiency desired.

by L. L. Nagel
Chief Electrical Engineer
Buell Engineering Co., Inc.

NOW THERE IS A DEGREE of choice in the selection of switchgear. Traditionally, precipitator switchgear has been similar to power plant and substation switchgear. In the early days of precipitator development, designers merely used what commercial equipment was available and power plant switchgear filled the bill since it was designed for high voltage conditions. The fact it was overdesigned from the standpoint of the current carrying capacity did little to effect modifications since the switches worked, and engineering talent was needed in other phases of development.

Early switchgear was of the multi-unit, two or three-position single-blade type and much of it is still in use. It is air cooled, and if installed outdoors is housed in a structure of its own for protection against the elements and for safety reasons. If installed indoors, it is caged to protect personnel from the high voltages present.

In the March issue of AIR ENGINEERING, *page 31, Mr. Nagel discussed the electrical requirements to be considered in the selection of an electrostatic precipitator including: gas volume; corrosiveness; temperatures; type of dust involved; location; and outdoor ambients.*

Vertical, rotary-type air switchgear was eventually developed for use with outdoor air-cooled mechanical rectifiers, and was mounted in a superstructure on the transformer-rectifier. By coupling two four - position, single - blade switching units together, and operating them with a single handle, half-wave, full-wave, and ground switching was achieved.

Compartment Enclosed Units

The compartment-enclosed units were made comparatively safe by means of key interlock systems. However, the possible failure of porcelain insulators due to mechanical shock is a detriment, as is the use of flexible jumper connectors between mechanically moving parts for positive ground-circuit protection. Therefore, from a safety standpoint, air switchgear leaves much to be desired.

Space-wise, the coupled arrangement of the vertical air switch makes a distinct saving over the substation type of switch previously used. However, the cabinet required for the coupled units is somewhat larger than required where only a ground or two-position selection is necessary. Flexibility is limited to the possible combinations of the four 90 degree positions of both switches.

Maintenance is necessary with all switchgear exposed to the air. When mechanical rectifiers are also used, corrosive conditions are intensified by the presence of ozone. With respect to cost, air switchgear is more expensive than switchgear which is immersed in oil within the transformer-rectified tank.

The safety of oil-immersed switches, either when immersed in the same compartment as the transformer-rectifier or when used as a separate unit in conjunction with an air-cooled tube-rectifier, is excellent.

The oil immersed switch requires less space for electrical clearances and thus allows for multi-deck design and a greater number of switching operations per unit than comparable-sized air switches. New inorganic construction and adhesive materials, such as epoxy resins, play an important part in reducing the size of oil immersed switchgear.

Multi-Position Double-Break Design

By the use of the multi-position double-break design (Figs. 1 and 2), units in either single or multi-deck combinations permit switching operations that are almost unlimited in scope.

Maintenance requirements for the oil immersed units are largely

limited to routine tests of the insulating medium for dielectric strength.

Production of these units on a quantity basis has brought the cost far below that of comparable air switchgear, although initial costs, as with all newly designed equipment, was high.

Ruggedness of design and operational life, after initial design problems were solved, has been extremely satisfactory in all respects.

Investigation into the use of switchgear in which switching elements are contained in a vessel of high pressure gas, indicates this method cannot compete price-wise with the fluid immersed design due to the cost of the pressure vessel and the standby supply of gas that is needed. However, the use of sulphur hexafloride, or other gases of a similar nature, offers a distinct future possibility for gas pressure type switches. The advantage of weight reduction, and the low cost of gas vs. fluid, plus the possibility of further reduction in container size, justifies further efforts on the part of manufacturers in trying to perfect a practical design using this medium of insulation.

High Voltage Cable

The high voltage cable leading from the switchgear to the precipitator electrodes is usually of either the hollow-core oil-filled type or the pipe-conductor-and-guard-run type. The desirable dry-type high-voltage flexible conductor has found only limited use in the precipitator field due primarily to unusual cable experiences associated with the .1 to 100 micro-second high-frequency feedback encountered in precipitator operation. As a step forward in the more complete control of this undesirable characteristic, air and oil-immersed chokes have largely replaced the non-inductive resistance type suppressors, but further development is required before the problem can be considered solved.

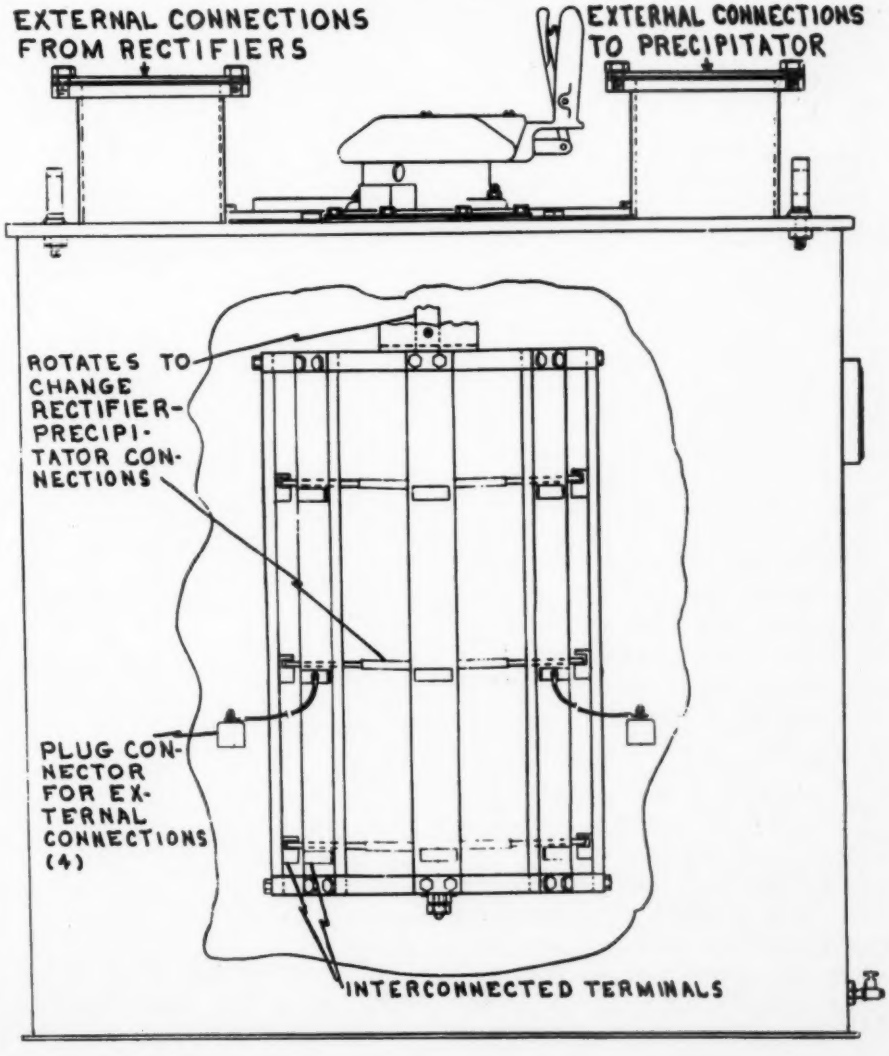
Emitting Frames

Emitting frames are the frames which support the electrodes carrying the d-c voltage that charges the dust particles as they travel through the collector. Today in some instances they have a linear electrode footage greater than twice the maximum previously thought possible. Frame-support insulators of higher dielectric strength, and improved emitting electrode design have contributed largely to this increased electrode footage. Also, simplified emitting-frame construction and collecting-plate design, have facilitated accurate alignment of these components, thereby eliminating a frequent objection against the use of large emitting frames. With the development of the silicon rectifier it has been possible to develop power packs which are capable of energizing one or more of these emitting frames under all conditions. The desirability of having less electrical units to power the same precipitator cannot be emphasized too strongly. Modern HV switching and reliability of rectifier operation permits considerable reduction in the number of power packs required for a given precipitator.

A precipitator comprising a number of precipitator emitting frames in series, should be designed so that power packs energizing successive frames are of the same capacity. That is, emitting units nearest the process should be of larger linear size than successive units due to extreme differences in dust loading of the gases as they pass through. However, if successive emitting units must be of the same linear size, then larger rated power units are necessary for successive emitting frames. At this time it is felt insufficient data is available to set a definite power requirement ratio between the primary and successive emitting frames. But, a study of installa-

(Please turn to following page)

Fig. 1: Schematic drawing of the multi-position double break design, units in either single or multi-deck combinations permit unlimited switching operations.


EXTERNAL CONNECTIONS FROM RECTIFIERS
EXTERNAL CONNECTIONS TO PRECIPITATOR
ROTATES TO CHANGE RECTIFIER-PRECIPITATOR CONNECTIONS
PLUG CONNECTOR FOR EXTERNAL CONNECTIONS (4)
INTERCONNECTED TERMINALS

Electrical Requirements For Electrostatic Precipitators

(Continued from preceding page)

tions for one industrial process indicates an approximate power ratio for successive frames of equal size approaching a value of 3:2 where uniform inlet grain loading and gas distribution is achieved. When the inlet grain loading is subnormal (less than 0.5 grain per cu. ft.), this ratio should be increased to as much as 2:1. In most installations the physical characteristics of the product will not affect the approximate ratios given. There have been occasional exceptions to the values expressed. For example, differences in process methods within an industry may sometimes require different power requirements for different series installations handling the same product. Wherever extremely high collection efficiencies are not required, it has been found economically desirable to construct precipitator units with parallel rather than series arrangements, in which case the units have equal capacity power packs.

Instrumentation

For many years instrumentation for precipitator equipment has been limited to the measurement of incoming a-c current and voltage. With the advent of the tube rectifier this important aspect has been expanded to include measurement of the d-c precipitator current and in some instances, through a voltage divider, the average d-c precipitator voltage. In some cases indicators of filament hours of operation and filament voltage have also been included.

Measurements of a-c and precipitator currents have considerable value in checking the high voltage electrical connections and operation of the particular unit energized. But the use of a high voltage d-c voltmeter will tend to lead one to erroneous data with respect to actual effective precipitator power. It reads the average d-c value of the resultant precipitator wave form which is not an accurate indicator for calculating the effective precipitator power. The use of a peak-reading voltmeter is of considerable value in checking actual precipitator power and power pack efficiency; the value of the a-c voltmeter now used is so limited that serious consideration should be given to eliminating it from the control panel and replacing it with a peak reading voltmeter.

Pulse Generation

The generation of either a full or a half-wave pulse from any one power pack has been found to be of value in practical field operations. Rectifiers of both electronic and metallic types are commonly designed so the output wave can be changed with ease where such units have two HV output bushings. The use of immersed high voltage switchgear as previously discussed has made this conversion a relatively simple operation.

Experimental operations in emitter energization with pulses shorter than half and full wave have been attempted, but the limited amount of work done plus distribution and economic problems involved, makes this method questionable for any possible increase in precipitator efficiency and/or saving in equipment costs.

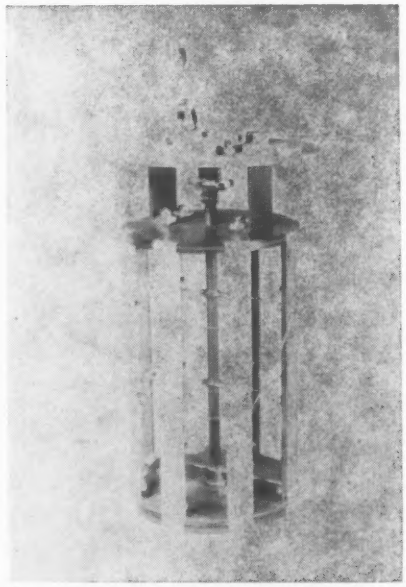


Fig. 2: Multi-position double break design. Single or multi-deck combinations permit many switching operations.

Half-Wave More Productive

The use of half-wave instead of a full-wave pulse is generally accepted as productive of a higher collection efficiency. One theory being that the higher peak voltage has a greater tendency to impart a charge on dust particles of a high resistivity than the comparative full-wave. This result has not been found to be true in instances where the characteristics of the dust apparently resists even the higher level of charge or where the higher peak value simply results in a higher leakage level of precipitator power. The most effective use of the half-wave conversion from an initial full-wave connection is the ability to pulse the connected frames at higher peak voltage without the resultant flashover that would occur with the frequency pulse value of the full-wave. The use of half-wave has frequently resulted in achieving the desired collector efficiency after operation with full-wave has failed. It must be remembered that the *average* power level of a unit is not a true evaluation either electrically or with respect to collection efficiency, as the average power is dependent upon the resultant ripple characteristic of a particular unit under the particular gas conditions of the moment. The desirability of a higher ripple characteristic is only proven by comparative tests when conducted under relatively similar gas conditions.

Collector Efficiency

Treatment of the gas by the introduction of fluids or small quantities of other gases may sometimes either improve the efficiency of collection, or attain the physiological advantage of a clean-appearing stack discharge. In general, a precipitator operating below 98 percent efficiency will have a visible stack emission or plume. In the case of wet process cement, especially in cold weather, this plume is quite heavy although it is comprised mostly of condensed water vapor. A glance at the stack emission several hundred yards distance from the point of origin will reveal any dust emission. To convince the layman this stack emission is mostly condensation is difficult indeed.

Alternate Proposals

As a further service to its prospective purchasers, most precipita-

tor manufacturers will offer alternate proposals and physical arrangements for consideration. This point should be considered if management requires their engineers to compose a specification setting up the various plant and equipment requirements before consulting a precipitator manufacturer.

Economics Of Achieving High Efficiency

Consideration should also be given to the economics of the problem, especially where a very high efficiency is desired, although not required from either a public relations standpoint or from a material recovery standpoint. The dollar difference between a precipitator designed for 97 vs. 99 percent can often discourage the immediate purchase of a unit which could, at the lower efficiency, often meet public demands and, at the same time, return enough salable material to the process to justify its cost.

The precipitator industry is quite unique in that it serves both the public and industry to the benefit of both. Few fields are in such a desirable position, and as a net result it has been found that manufacturers of dust collection equipment will attempt to reduce equipment cost to its most advantageous customer level consistent with the particular requirements of the industry and public. ▲▲

Use the Communications Center, page 51, to receive more information about any product advertised, any new literature or new product described. Circle the number on the postage-free card that refers to the item of your interest, add your name and address and mail.

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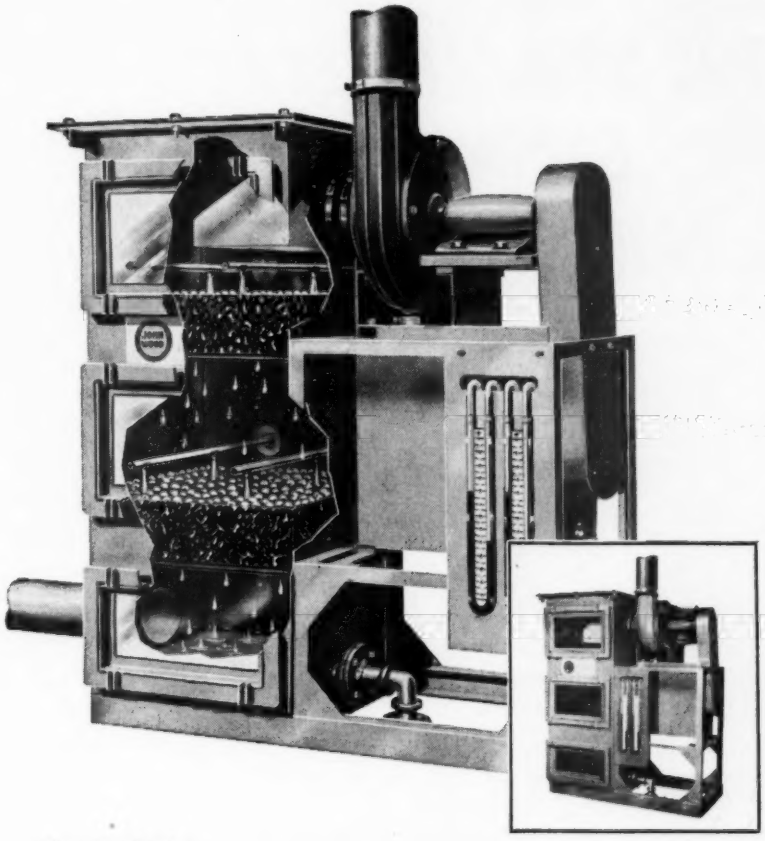
New Ideas On Dust And Fume Control



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This unique approach to the removal of fumes, vapors and dust from ventilation systems offers a new high in operating efficiency. In fact, efficiencies in adsorption and absorption of NO_2 exceeding 95% and of HCl of virtually 100% have been obtained.

Two horizontal beds operating under flooded conditions break the air stream into bubbles 1/16 inch in diameter. Completely surrounded by the scrubbing liquid and subject to impaction forces caused by continuous change of direction, the bubbles break up. Rapid absorption is the result.

The John Wood Flooded-Bed Scrubber is a compact, integrated unit. Construction is corrosion proof and provides easy access for servicing.

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[For more information circle #28 on page 51 reply cards]

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[For more information circle #29 on page 51]

Air Conditioning At Ship 'N Shore

(Continued from page 27)

- **Superior, longer-lasting finishes in pressing operation due to lower humidity in pressing department.**

Air conditioning at Ship 'N Shore points up a growing trend toward air conditioning in factories of all types, notably those above the Mason-Dixon line. The benefits of improved employee relations, increased production, higher quality products, have proved to be real indeed, and, like Ship 'N Shore, these plants have found substantial returns realizable from their cooling equipment investment. Further such articles on the economic benefits of factory air conditioning will appear in future issues of AIR ENGINEERING. ▲▲

CREDITS

Consulting Engineer . . . *Cronheim and Weger*
Centrifugal compressor . . . *Carrier Air Conditioning Co.*
Air handling equipment . . . *Carrier Air Conditioning Co.*

Glass-Fabric Baghouse

(Continued from page 33)

1.5 to 3.12 grains per cubic foot. Particulate matter from thimble tests was also analyzed. It was found that 8.0 percent of this was less than 1 micron in size; 82.0 percent of 1 to 3 microns; 7.4 percent 3 to 5 microns and 6.2 percent of 5 to 10 microns.

The particles are round and elliptical. Specific gravity of the particulate matter was found to be 4.16.

The smallest particle observed was 0.005 microns, compared with the average size of tobacco smoke particles of 0.2 microns. Several varieties of the particles tested had electrostatic charges which caused them to flocculate and agglomerate to the magnitude of 50-80 microns.

The particles consist largely of metallic oxides, such as iron oxide, calcium oxide, zinc oxide, etc. The percentages of these vary, of course, from heat to heat.

From the company's various tests and preliminary data, basic requirements for controlling the electric furnace fume-dust emissions were established. Of the material to be extracted, 90 percent was less than 3 microns, and of this 8 percent was sub-micron. The fume temperature varied from 200 to 500° F.

Selection of appropriate filter equipment was no easy matter. Many types of dust and fume collectors were given careful consideration as was the experience gained from the electrostatic precipitator at the company's Los Angeles steel plant. Based on these considerations it was agreed that a bag-house type collector employing silicone-treated glass-fabric bags appeared to have the best chance of success. However,

before installing a full-scale unit it was deemed advisable to test a pilot-size collector for the purpose of obtaining certain design data and operating characteristics. For this purpose, one of the manufacturers made available a small test unit. It was installed near the base of the fume stack and was tested under actual operating conditions.

Briefly, the filter unit works like a large vacuum cleaner. Furnace fume enters through the lower end of each vertically suspended bag, and particulate matter is filtered out as the gas passes through the interstices in the silicone-treated glass fabric.

As the filtering process continues, particulate matter builds up, and this, of course, increases the resistance to the flow of gas. Therefore, in order to maintain high flows through the filter and a minimum static head, or back pressure, a cleaning cycle was incorporated.

The load and clean cycles of each section are automatically controlled to permit each section to complete approximately two cycles of load and clean each hour. This is done by reversing the flow pulling atmospheric air through the suspended bag, an operation that permits dust particles to fall into the hopper below the inlet of the bag.

Based on successful operation of the pilot plant after weeks of testing, decision was made to install a full-size unit. This was housed in a structure 38 ft. wide, 57 ft. high and 63 ft. long.

Installation of the full-size fume-dust filter unit was completed early this year, and on the basis of its successful operation in the months that have followed, it is clear that the plant's fume-dust problem has been solved. In a recent series of articles on air pollution by the Seattle Post-Intelligencer, Bethlehem's Seattle Plant was listed as one of two companies which had eliminated smoke nuisances on its own initiative.

Following is a description of this full-scale filter unit.

During the entire melting, refining and tapping period, fume is collected from the electric furnace through an opening in the roof, then carried downward through a refractory-lined chamber equipped with a series of water spray nozzles. These are automatically controlled to maintain a constant fume temperature of approximately 500° F.

The fume then continues through a steel duct, 7 feet in diameter and 450 ft. long, to a fan rated at 90,000 cfm capacity at standard conditions.

The evacuation system is automatically controlled, so as to maintain a negative water column pressure of 0.05 to 0.10 inches within each furnace.

From the fan, the fume enters the main bag house distribution manifold under 3 to 5 inches water column pressure. Its temperature in the bag house inlet manifold varies from 300 to 450° F.

The bag house contains 792 silicone-treated glass-

(Please turn to page 45)

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for heating jobs up to
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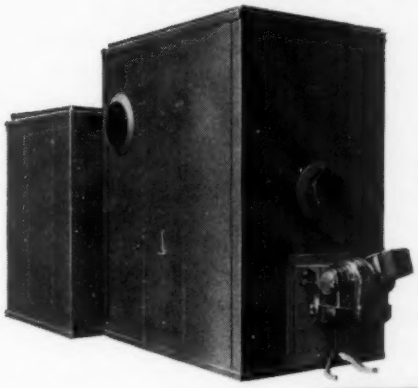

Oil-fired Powerated tubular model with separate blower cabinet.

Powerated model with cabinet enclosing both burner and blower.

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[For more information circle #30 on page 51]

New PRODUCT OF THE MONTH . . . .

New School Ventilator Controls Air With Full-Damper System

A new concept in providing positive regulation of comfort for low budget school classrooms has been announced by the Modine Manufacturing Company.

The new Modine concept controls the air, not the water and is accomplished through a unique full-damper system.

Included in the system are:

- A face-and-bypass insulated damper which directs air through and around the heating coil according to comfort requirements;
- An insulated anti-wipe damper which permits complete isolation of the coil, eliminating heat pick-up from the coil, and also eliminates any coil freeze-up;
- Indoor and outdoor dampers which assure proper blend of fresh and recirculated air.

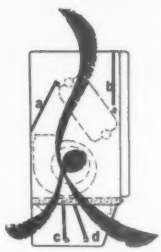
This full-damper system insures temperature control with no delay between comfort demand and comfort delivery. Changes in classroom temperature and fresh-air requirements automatically change the system to maintain pinpoint comfort levels.

School-Vent heats with steam or hot water and cools with central-source chilled water. Five sizes up to 1500 cfm heating and cooling are available. If necessary, cooling can be added later. The unit can be ceiling or wall mounted, partially and fully recessed or fully exposed.

According to Cary C. Wilson, Modine sales vice president, one of the most significant characteristics of the system is its inherent economies. He said, "While exact comparative evaluations are still being made, we can foresee system economies of at least 33 percent over present-day techniques."

NIGHT—ROOM UNOCCUPIED

Overnight, on weekends or during other periods when classroom is unoccupied, SCHOOL-VENT heats primarily by convection. Face-and-bypass (A) and anti-wipe (B) dampers are open. Fan starts only when temperature drops below predetermined setting. Fan cycles briefly a few times nightly. Indoor damper (D) is open, outdoor damper (C) closed for maximum operating economy.



ROOM OCCUPIED

During morning warm-up (prior to room occupancy), fan starts and runs until room temperature reaches day-time setting. Throughout warm-up, all dampers remain in nighttime positions and room air is recirculated for maximum heat gain. However, with room occupied and the temperature rising, outdoor damper (C) opens to blend proper amount of fresh air with room air. At the same time, face-and-bypass (A) and anti-wipe (B) dampers automatically adjust to maintain desired room temperature.

FULL VENTILATION

When room temperature continues to rise because of solar heat gain and body heat of occupants, SCHOOL-VENT's fresh-air damper (C) and recirculation air damper (D) modulate to increase the proportion of outside air . . . up to 100% if required. When SCHOOL-VENT is providing full ventilation, the face-and-bypass (A) and anti-wipe (B) dampers are closed so that fresh air completely bypasses the coil.

By pushing a button on the panel of the School-Vent it is push-button lubricated with metered amounts of lubricant delivered to every oiling point. The system is orificed to assure equal distribution.

Modine research has also changed and reduced the character of the noise normally associated with this type equipment. This has been achieved through "attention in total" to the noise factor.

By utilizing an exceptionally quiet two-speed motor isolated by rubber pads the noise factor has been reduced. Fans are run at low rpm and are sized to minimize tip speeds, also over-all decibel ratings have been reduced.

According to Modine additional School-Vent features include:

Easy access control panels. Hinged control panels open with key-lock latches. There are no troublesome screws to hamper servicing.

Easy filter removal. No panels need be removed to replace the

GP-100 . . . a new line of standard-dimensional, precision-crafted work tables . . . created after on-the-spot studies of today's exacting white room requirements.

ALL THE MOST WANTED FEATURES

- adaptable — fits any space, fills any production requirement
- durable — rugged steel frame for strength, stability, permanence
- mobile — equipped with heavy-duty industrial-weight casters
- sanitary — smooth surfaces, dust-trap free for white room use
- versatile — efficient clip-on tops allow swift changeovers
- economical — saves on cost of installation, requires no maintenance

SWAP TOPS

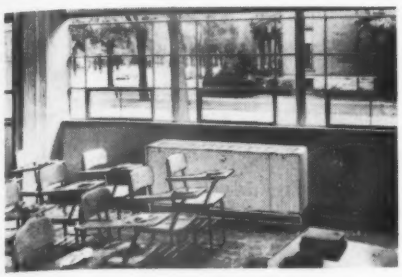
BROCHURE ON REQUEST. LEITCH-HUARD CORP., COMMERCIAL STREET, MANCHESTER, N.H.

[For more information circle #31 on page 51]

Product Of The Month . . .

dirty filter. Just slide out the old, slide in the new.

Spacious end compartments to simplify installation and servicing. The generous sized end sections provide ample work area for piping, controls and electrical connections.



Student-proof cabinets. Special die forming construction here has enabled Modine to achieve with 16 gauge metal greater strength than the traditional 14 gauge. All surfaces are bonderite treated and finished with long-wearing baked-on enamel in a choice of six decorator colors. Front panels are covered with attractive scuff resistant Vinyl.

The School-Vent can be used with fin-tube radiation for downdraft protection along broad expanses of window wall.

The entire unit is designed to operate with a minimum of controls and maintenance. ▲▲

To receive more information on the Modine School-Vent Product of The Month,

Circle #100 on page 51.

Glass Baghouse

(Continued from page 43)

fabric bags, each 11½ inches in diameter and 25 feet long. These are made up in 12 sections with 66 bags per section. Each section has a fume inlet valve, a valved connection to a negative manifold for deflation and cleaning, and a dust hopper complete with screw conveyor system to elevator for railroad hopper car loading. ▲▲

CREDITS

Bags . . . *Menardi & Company*
Baghouse system design and installation . . . *Western Precipitation Div., Joy Mfg. Co.*

Dust Control is a job for Engineers

The "rule of thumb" methods of the inexperienced, or the "engineering rules" of an experienced design, fabrication, and installation firm—which will you select for your dust control problems?

Kirk and Blum offers you . . .

ENGINEERING—a staff of qualified engineers with proven ability to solve your dust control problems.

RESEARCH—continuous research on full scale equipment, to develop the most efficient systems.

EXPERIENCE—over 50 years of dust control service.

Every Kirk & Blum installation is based on a complete service: Design — Fabrication — Installation, backed by K & B's acceptance of One Undivided Responsibility for the system to assure your satisfaction.

On your dust control problem consult Kirk and Blum, craftsmen in dust control, where fine craftsmanship is appreciated. The Kirk & Blum Manufacturing Company, 3130 Forrer St., Cincinnati 9, Ohio.

KIRK & BLUM DUST CONTROL SYSTEMS

[For more information circle #32 on page 51 reply cards]

New Literature

New Brochure On "Infra-Red Gas Heaters"

Lambert Industries has released a new brochure on their line of Infra-Red gas heaters.

Brochure lists uses of heaters, illustrates the heaters, and gives dimensions and Btu/Hr maximum input for each model available.

Also available is a summary on "Sizing and Locating Infra-Red Generators."

Circle #131 on page 51.

"The Design And Operation Of Local Exhaust Systems"

A 63-page book has been released by the American Standards Association and sponsored by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, American Industrial Hygiene Association, and the Air Moving and Conditioning Association.

The book details: plant construction and layout; exhaust hoods; exhaust ducts; air cleaning equipment; exhausters; construction and layout; operation and maintenance; checking operation of local exhaust systems; and revision of American Standards.

Circle #132 on page 51.

How To Measure Rotating Power

A new 12-page brochure, issued by Power Instruments, Inc., illustrates how to measure the torque characteristics and speed of motors, gear trains, servo mechanisms, and potentiometers. The brochure covers torque ranges from ¼ gm-cm to 200 lb-in.

It also includes formulas for computing power and efficiency and methods of using stroboscopes and tachometers for analyzing rotating motion.

Circle #133 on page 51.

Axial-Flow Fans

Axial-flow fans for heating, cooling, ventilating, fume removal, and drying systems, are described in a new 16-page illustrated bulletin available from L. J. Wing Mfg. Co.

Fans with direct-connected motors and designs with V-belt drive are covered. Features, construction details, optional equipment, specifications, and tables of capacities and dimensions, are included in the new bulletin.

Circle #134 on page 51.

Psychrometric Chart

Trane Company has issued a new psychrometric chart, designed for greater utility and accuracy in the selection of air conditioning systems and equipment.

The chart is self-contained and provides information needed to solve almost all air conditioning problems without reference to auxiliary material. According to Trane, it also reduces error to less than one percent.

Circle #135 on page 51.

SPLIT-EYELET CONNECTORS
For faster, easier connection of spray nozzles, branch lines and equipment to piping and tubing carrying liquids, gases or air up to 250 psi. Write for Bulletin 93.
FOR BETTER PERFORMANCE
SPRAY NOZZLE ACCESSORIES
ADJUSTABLE JOINTS
For easy, exact adjustment of spray direction. Made in size for ¼" to 2½" pipe in brass, steel and stainless steel. Write for Bulletin 97.
. . . EASIER INSTALLATION
LINE STRAINERS
Special non-collapsing screen design for pressures up to 125 psi, for all pipe lines from ¼" to 6" size. Also high pressure strainers for up to 5,000 psi service. Write for Bulletin 94.
FOR COMPLETE SPRAY NOZZLE INFORMATION WRITE FOR CATALOG 24
SPRAYING SYSTEMS CO.
3202 RANDOLPH STREET • BELLWOOD, ILL.

[Circle #33 on page 51]

TO KEEP

AIR ENGINEERING

Coming each month

use the handy subscription card in this issue or send your order on your letterhead to:

Subscription Manager

AIR ENGINEERING

450 West Fort Street

Detroit 26, Michigan

1 Year $3 — 2 Years $4.50 — 3 Years $6

New PRODUCTS

Ultrasonic Cleaning System For White Room Use

Purpose: The new Blackstone Corp., Model SG-3 Ultrasonic System, although primarily for cleaning is also used for dissolving, blending, emulsifying, de-aerating, and impregnating.

Features: The SG-3 is available with standard interchangeable tanks of 4, 5, and 8 gallon capacity for increased sonic power density, smaller 1, 2, and 3 gallon tanks are also available.

Tank lifts off stainless steel covered housing without interrupting electrical connections. Low-level drain with screw cap, permits emptying tank while in operating position.

The patented magnetostrictive transducer is constructed of more than 200 individual nickel elements. The transducer will not heat processing fluids when work is being done at low temperatures and provides maximum sonic output even with fluids at temperatures up to 400° F.

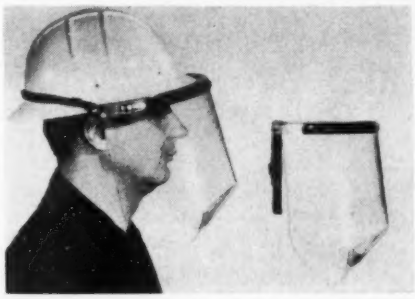
Circle #71 on page 51.

New Face Shield Worn With Safety Hat

Purpose: From General Scientific Equipment Company a new face shield that is valuable in protecting eyes, face and under chin area. It is adapted to operations where splashing is a problem.

Primary use will be by the chemical and oil industries and wherever full face coverage is required against acids, chemical sprays, foreign particles and other fragments.

Features: Worn with a safety helmet, the shield is lightweight, and can be used for pouring, dipping from vessels, grinding, buffing,



polishing, bottling, spot welding, wire brushing, cleaning, metal band sawing and woodworking.

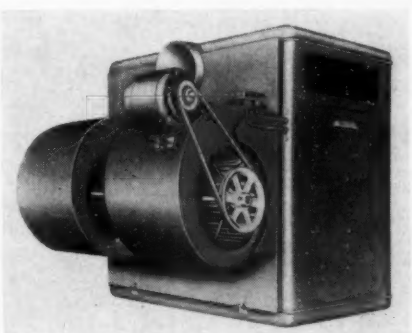
Full, wide, unrestricted vision and audibility is provided by the new shield, named "The Mark I." The head gear fits all safety helmets, and is 16 in. x 9 in. with .040 in. thick visor for impact resistance. Other sizes can be made for special applications.

Circle #72 on page 51.

New Dual Blower Systems

Purpose: Reznor Manufacturing Company has announced development of new and improved dual blower systems for its blower type gas-fired unit heaters and its modular duct furnaces.

Features: The dual blower systems are used with 250,000 Btu and 300,000 Btu US Series blower type unit heaters, and also with the DSB Series packaged blower systems for Reznor's 250,000 and 300,000 Btu modular duct furnaces.



The new dual blower systems are powered by a single ½-horsepower motor, with the blowers mounted on a common drive shaft. Two ⅓-horsepower motors formerly were used to drive the blowers,

(Please turn to following page)

NEW! Cambridge ABSOLUTE® Filter Vacuum Cleaner

Safely Handles Sub-Micron Radioactive and Toxic Dust

This new portable vacuum cleaner is equipped with a Cambridge ABSOLUTE Filter individually tested for a minimum efficiency of 99.97% on 0.3 micron particles and specially designed to permit its easy removal and replacement.

Air is prefiltered through a high-efficiency Dacron bag on a special frame assembly which holds the bag in full-open position during operation and provides for safe removal without collapsing and redistributing collected dust. The collection tank has a recoverable capacity of 1⅔ bushels of dry material and, when used for liquid collection, the liquid level can be checked visually, easily and quickly. Tank is quickly released for emptying and cleaning.

Exhaust air is deflected gently upward and outward around the entire perimeter so as not to disturb uncleaned areas. Heavy-duty 1-hp. motor and triple-turbine blower located in the clean-air side of the ABSOLUTE filter provides a flow rate of 154 c.f.m., free-air capacity. *Turbo-vacuum head is available for blowing fully filtered air.*

Take advantage of the economy and convenience of unitary vacuum operation in areas heretofore limited to central-system operation. Write for full information.

Cambridge Filter Corporation

744 E. Erie Blvd., Syracuse 1, N.Y.

[Circle #35 on page 51]

New PRODUCTS

(Continued from preceding page)

which previously were mounted on individual shafts.

Fafnir bearings are incorporated as standard equipment in the new systems. These bearings may be ordered packed with a silicone grease which guarantees their functioning in environments ranging from -40° to +300°F.

Circle # 73 on page 51.

New Portable Rescue Breathing Kit

Purpose: The American Optical Company's Safety Products Division has started distribution of Ambu, a light, portable, rescue breathing it.

Features: The kit is designed to open easily and contains a resuscitator to give air and start breathing again. It also contains a foot-operated suction pump to clear the breathing passages fast.

The Ambu resuscitator bag holds 1,000 cubic centimeters of air

and will deliver up to 700 cubic centimeters into the lungs when squeezed.

Circle # 74 on page 51.

Electrical Pressure Gauge

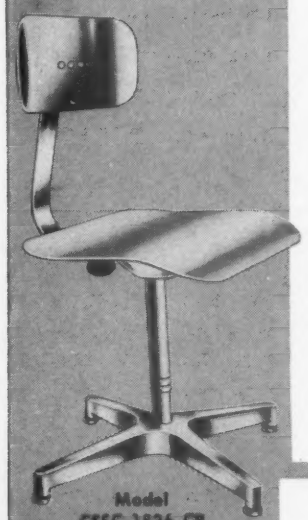
Purpose: Hastings-Raydist, Inc. announces a new electrical pressure gauge. Utilizing an extremely small pressure transducer it is suited to remote measurement, alarm or control of pressure in the range of 0-2500 psig. The electrical output can also be used for recording.

Features: The pressure gauge operates on the noble metal compensated thermopile principle and is intended for use in air and gaseous systems. Operation is from 115 volt a-c, 60 cycle line.

Multi-position pressure gauges utilizing up to 5 transducers with a single instrument are also available. Transducers are interchangeable without recalibration or adjustment and are priced at $257.50 complete, extra transducers are priced at $60.00 each.

Circle #75 on page 51.

SPECIAL CHAIRS FOR WHITE ROOMS AND DUST FREE AREAS



- All Enclosed Mechanism
- No Oil or Grease
- All Chrome Plate Finish
- Easily Cleaned
- 12 Ga. All-Steel Seat; 14" x 15¾"— Waterfall Form. Sand Blast Surface. Adjusts 18" to 26".
- 12 Ga. Steel Backrest; 6" x 13¾"—with tempered steel backrest support. 6 inch horizontal adjustment. Backrest folds down to make easy cleaning.
- Cast Iron Base; 20-inch spread. 1½" steel glides.

Other White Room chairs with lacquered plywood seat and backrest.

FREE TRIAL Use an AJUSTRITE chair for 30 days without obligation. Prove to yourself the many advantages AJUSTRITE offers in comfort, utility and economy. Write today—we'll do the rest.

10 YEAR GUARANTEE

Model CSSC-1826-CP

32 Models for Factories • Schools • Laboratories • Hospitals • Offices

AJUSTRITE CHAIRS AND STOOLS

AJUSTO EQUIPMENT CO.
Bowling Green, Ohio

[Circle #34 on page 51]

"IS WHITE ROOM DUST YOUR PROBLEM?"

If so the *CLEAN TREAD MAT* is the answer to your question. The Mat when placed in front of the entrance to the White Room Area is the perfect trap for walk in dust. Easy to clean and maintain.

THE MIRACLE MAT THAT PICKS UP EVERY TRACE OF DUST AND DIRT *INSTANTLY*.

CLEAN TREAD DIVISION
of
M. P. & C. CORP.
157 Regent Street — Cambridge 40, Mass.
TRowbridge 6-6122

[For more information circle #42 on page 51]

Hermetic Centrifugal Refrigerating Machine

Purpose: Carrier Air Conditioning has added to their line of products a hermetic centrifugal refrigerating machine.

Features: According to Carrier the hermetic centrifugal refrigerating machine with 2,000 tons of cooling capacity is the largest of its kind ever built.

Circle #76 on page 51.

Lined Rubber Tubing

Purpose: Now being offered by Pennsylvania Fluorocarbon Co.,

Inc. is the new Teflon® lined rubber tubing for use in a wide variety of applications, as transmitting solvents, chemicals, petroleum products, and waste material.

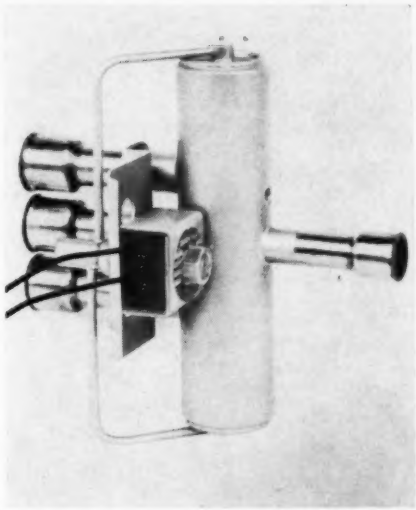
Features: The Teflon liner is available in ⅛ in. through 1 in. I.D. sizes covered with ⅛ in. Neoprene rubber. According to Pennsylvania Fluorocarbon Co., Teflon tubing is unaffected by any commercial chemical, does not contaminate food or fluid stream, has the widest service temperature range of any plastic, and good dielectric strength (500 to 2000 volts/mil).

Circle #77 on page 51.

Four Way Reversing Valves

Purpose: New all-metal, four-way reversing valves for control of refrigerants in reverse cycle air conditioning systems, heat pumps and hot gas defrost applications have been unveiled by General Controls Co.

Features: Designated the "KV-44," the new device features hermetic valves with full ported poppet type pilot valve and plastic encapsulated coils. The pilot valve is mounted to the main valve, permitting a shift of the main slide valve with both low and high system pressures.

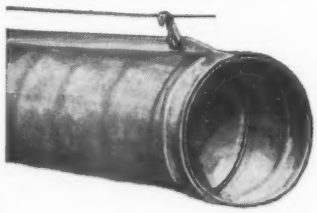


Other specifications are: coil voltage, all commercial voltages-a-c; continuous coil power requirement, 18 VA a-c, inrush, 29 VA; Max. operating pressure differential, 500 psi; and min. changeover pressure differential, 40 psi.

Circle #78 on page 51.

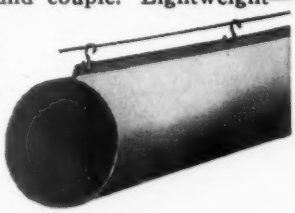
NEW!

ABC WIRE REINFORCED



Flexible Ventilation Tubing

For safe, economical removal by suction of fumes, fouled air, dust from bilges, manholes, tanks, furnaces, mines, or for blowing in fresh air. Neoprene coating is airtight, resists friction, oil, moisture. Withstands flexing. Reinforcing wire completely covered. Easy to hang and couple. Lightweight—only 1/3 of metal duct. Flame resistant. Retractable for carrying or storage. Also plain tubing for blowers.



AMERICAN BRATTICE CLOTH CORP.

Send for Catalog.

340 King's Hwy., Warsaw, Indiana

[For more information circle #36 on page 51]

FOR 99 PLUS % EFFICIENT CORROSIVE FUME REMOVAL and MAINTENANCE FREE OPERATION

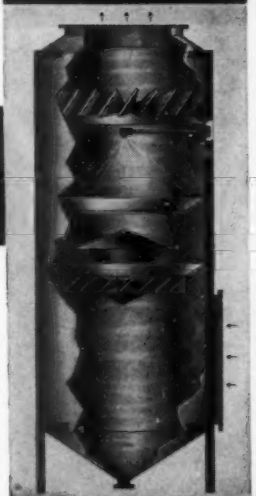
CARPART

(TYPE CF)

FUME SCRUBBERS

500 cfm to 40,000 cfm Capacities

efficiencies on
- CHROMIC ACID 99.4% to 99.8%
- SULFURIC ACID 99.4% to 99.5%
- BRIGHT DIP MIX 99.8% to 99.9%



Fabricated Entirely of *Boltaron* unplasticized PVC

- LOWER INITIAL COSTS!
- LOWER ERECTION COSTS!
- NO MAINTENANCE COSTS!

Effectiveness due to combination of 4 stage water curtain with baffled impingement and continuous centrafugal heavy particle separation.

For Engineering and Application Data on Boltaron PVC Fume Scrubbers and Plastic Exhaust Systems, contact . . .

CALL SAratoga 5-5144

OWOSSO, MICHIGAN

CARPART CORPORATION Mfg Div

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Chemical Engineers
Industrial Air Pollution Abatement
L. B. Hitchcock.....Edwin Cox
John H. Schaefer, Technical Advisor
60 East 42nd St., New York 17, N. Y.

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RATES—Classified advertising is run in 6-point type (this size) under suitable headings. Minimum rate $5.00 for forty words or less. Extra words .15 each. Box addresses, with usual services, count as five words. Payment required with order. No agency commission, no checking copies. Closing date first of month preceding month of issue. No proofs will be submitted prior to running, but proof will be forwarded for record. No display advertising under classified headings. AIR ENGINEERING, 450 W. Fort Street, Detroit 26, Mich.

POSITIONS AVAILABLE

OPPORTUNITIES FOR SCIENTISTS IN AIR POLLUTION RESEARCH PROGRAM: Chemical Engineers—Chemists—Industrial Hygienists—are you interested in locating, identifying quantifying gases and related pollutants with the objective of improving the quality of the air we breathe?—If so, we're interested in **you**. We have a big challenging job to do. We are inviting men with appropriate scientific and report-writing skills to work with us. Salary about $9,000 to $10,600, with Civil Service benefits and requirements. Write Director, ROBERT A. TAFT SANITARY ENGINEERING CENTER, 4676 Columbia Parkway, Cincinnati 26, Ohio.

MANUFACTURERS' REPRESENTATIVE wanted for industrial dust and fume collectors. Exclusive territories. Write P. O. BOX 4701, Detroit 34, Michigan.

MANUFACTURERS' AGENTS — We need many additional agents all over this country to sell a most successful wet dust collector, manufactured and sold in 12 countries besides the U.S.A. We have been in business for 15 years and have the product and the reputation on which to expand our business. Only qualified ventilating engineers need apply. Our agents have been notified of this advertisement. Please reply BOX AE-8601, Air Engineering.

BUSINESS OPPORTUNITIES

PROFIT-MAKING CARRIER air conditioning dealership, southern metro area; wholesale, retail, complete service equipment, 12 radio controlled trucks; going business. Price: $200,000; terms. PAUL H. CHAPMAN, Broker, 1182 W. Peachtree, Atlanta, Ga.

MISCELLANEOUS

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